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28th Annual Session

AMERICAN CONGRESS OF PHYSICAL MEDICINE

August 28, 29, 30, 31, September 1, 1950

HOTEL STATLER BOSTON

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American Congress of Physical Medicine

28th Annual

Scientific and Clinical Session

and

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August 28, 29, 30, 31, Sept. 1, 1950

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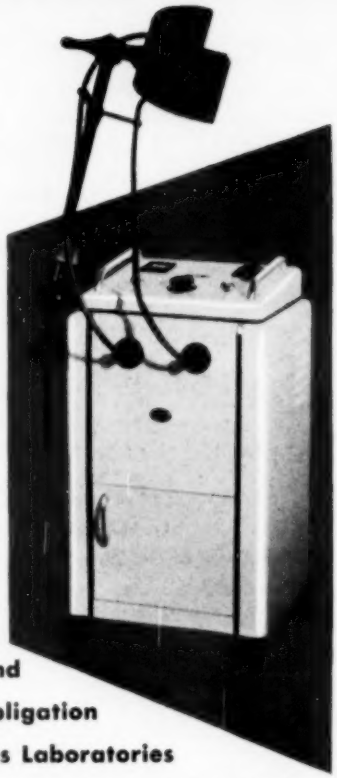

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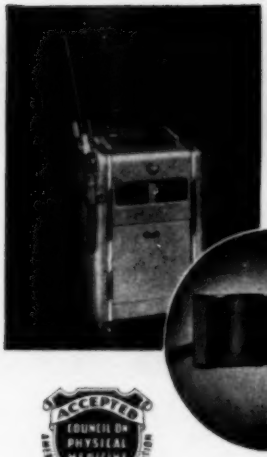

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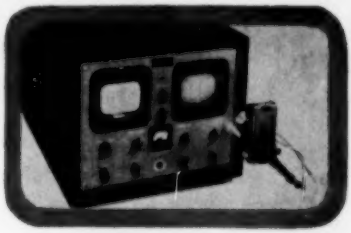

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THE EFFECT OF CONTRAST BATHS ON THE PERIPHERAL CIRCULATION IN PATIENTS WITH RHEUMATOID ARTHRITIS *

JOSEPH P. ENGEL, M.D.
Fellow in Physical Medicine, Mayo Foundation

KHALIL G. WAKIM, M.D.
Section on Physiology, Mayo Clinic

DONALD J. ERICKSON, M.D.

and

FRANK H. KRUSEN, M.D.
Section on Physical Medicine, Mayo Clinic

ROCHESTER, MINN.

Hydrotherapy has been employed empirically for centuries as a treatment for bone and joint disorders. Such workers as Winternitz and Strasser (cited by Kellogg[1]), Baruch,[2] and Kellogg[1] have stimulated the development of scientific hydrotherapy. The favorable response of arthritic joints to various forms of hydrotherapy has led to the search for specific effects. Studies of skin temperature[3] in cases of arthritis indicate that the circulation increases in response to surface application of hot water and decreases when cold water is similarly applied. It was considered of some interest to investigate by means of the venous occlusion plethysmograph the response of the peripheral circulation in the extremities of arthritic patients to contrast baths.

Kellogg[1] described the alternate foot bath, in which the feet are placed in hot water for two to three minutes, then in cold water for about one minute. This procedure was alternated a number of times. He concluded that the alternate foot bath was a more highly excitant measure than the cold foot bath and was especially useful in cases of chilblains, local asphyxia, habitual coldness of the feet and sweating feet. Since then the contrast bath has been employed in the treatment of certain peripheral vascular diseases.

One of us (Krusen[4]) stated that contrast baths had been used empirically and apparently with considerable success in the treatment of patients with rheumatoid arthritis. The temperatures recommended have been 10 to 18.3 C. for the cold water and 37.8 to 43.3 C. for the hot. Alternation in temperatures was considered as an activator of the peripheral blood vessels by causing alternate dilation and constriction of the small arterioles and capillaries.

Woodmansey and associates[3a] found that in order to obtain the maximal effect on the peripheral vasculature it was necessary to apply hot water for

* Read at the Twenty-Seventh Annual Session of the American Congress of Physical Medicine, Cincinnati, Sept. 9, 1949.

1. Kellogg, J. H.: Rational Hydrotherapy, Battle Creek, Mich., Modern Medicine Pub. Co., 1918.
2. Baruch, Simon: Principles and Practice of Hydrotherapy. A Guide to Application of Water in Disease, New York, W. Wood and Company, 1898.
3. (*a*) Woodmansey, A.; Collins, D. H., and Ernst, M. M.: Vascular Reactions to the Contrast Bath in Health and in Rheumatoid Arthritis, Lancet **2**:1350 (Dec. 19) 1936. (*b*) Moor, F. H.: Hydrotherapy for Local Injuries and Infections, Arch. Phys. Therapy **22**:646 (Nov.) 1941. (*c*) Comroe, B. I.: Arthritis and Allied Conditions, ed. 3, Philadelphia, Lea & Febiger, 1944. (*d*) Holbrook, W. P., and Hill, D. F.: The Management of Atrophic Arthritis in Relation to the Different Phases of the Disease, in: Proc. Am. Assn. for the Study and Control of Rheumatic Dis.: First Annual Meeting and Third Conference Held at Cleveland, June 11, 1934, pp. 79-87. (*e*) Hines, E. A., Jr., and Kvale, W. F.: Circulation: Effects of Heat and Cold, Exercise and Posture, in: Glasser, O.: Medical Physics, Chicago, The Yearbook Publishers, Inc., 1944. (*f*) Martin, G. M.; Roth, Grace M.; Elkins, E. C., and Krusen, F. H.: Cutaneous Temperature of the Extremities of Normal Subjects and of Patients with Rheumatoid Arthritis, Arch. Phys. Med. **27**:665 (Nov.) 1946.
4. Krusen, F. H.: Physical Medicine, Philadelphia, W. B. Saunders Company, 1941.

periods of six minutes and cold water for periods of four minutes alternately. The hot water bath was kept at a temperature of 41.6 to 45 C. by a small electric immersion heater, and the cold water bath was maintained at a temperature of 8.3 to 15.5 C. by the addition of ice. They asserted that the contrast bath, properly applied, caused active, not passive, exercise of the vasculature and tended to reeducate the vessels to respond promptly and efficiently to changes in the temperature of the environment. They recommended contrast baths to effect a ready vasodilation and to reduce sensitivity to cold. Furthermore, they demonstrated that patients with rheumatoid arthritis showed a "poorer" response to contrast baths than did normal persons. They concluded that this was the result of disuse rather than of vasospasm.

Moor[29] stated that alternate application of hot and cold water is exceedingly effective in stimulating the local circulation. Comroe[30] asserted that contrast baths are of assistance in relieving pain and stiffness in joints, especially in cases of degenerative joint disease, in that they often have a more analgesic effect than heat alone. Holbrook and Hill[31] recommended contrast baths as especially useful for the treatment of hypertrophic and atrophic arthritis.

Hines and Kvale[32] stated that contrast baths, like postural exercises, have been widely used in peripheral vascular disease but that there is no evidence that permanent improvement of the circulation was produced. Martin and associates[33] observed that maximal vasodilatation in arthritic patients, as indicated in temperature recordings, was not obtained even when the short period of one minute's immersion in cold water was alternated with four minutes of hot water. They concluded that a period of ten to fifteen minutes' immersion in hot water is necessary to obtain initial maximal vasodilatation.

In 1897 Amitin[3] demonstrated plethysmographically that heating the arm increased, and cooling decreased, its volume. She found that sudden great changes in temperature, whether cold or hot, always produced vasoconstriction. Hewlett and Van Zwaluwenburg,[5] in 1909, observed that blood flow in the arm increased in response to surface heat and decreased in response to cold, and that general heating measures caused a greater increase in blood flow in the arm than did local surface heat. Hauffe[7] observed similar plethysmographic responses. He stated that in order to obtain maximal peripheral dilatation it was necessary to use slowly increasing degrees of heat rather than sudden high temperatures. Kellogg[1] demonstrated by means of the plethysmograph that ice applied to the elbow caused a decrease in the volume of the forearm. Landis[8] found that heat produced capillary dilatation and increased intracapillary pressure. He found also that cold produced primary vasoconstriction and reduction in intracapillary pressure lasting five to eight minutes, which were followed by a dilatation which exceeded the preceding normal state.

Goldschmidt and Light[9] found that heat caused a marked acceleration of blood flow and decreased the differences in arteriovenous oxygen saturation. Drury and Jones[10] observed that moderate heating caused acceleration

6. Amitin, Sarah: Ueber den Tonus der Blutgefässe bei Einwirkung der Wärme und der Kälte, Ztschr. f. Biol. **37**:13, 1897.
5. Hewlett, A. W., and Van Zwaluwenburg, J. G.: The Rate of Blood Flow in the Arm, Heart **1**:87, 1909.
7. Hauffe, George: Die physikalische Therapie des praktischen Arztes, Med. Klin. **21**:1811 (Nov.) 1925.
8. Landis, E. M.: Micro-injection Studies of Capillary Permeability: I. Factors in the Production of Capillary Stasis, Am. J. Physiol. **81**:124 (June) 1927.
9. Goldschmidt, Samuel, and Light, A. B.: The Effect of Local Temperature upon the Peripheral Circulation and Metabolism of Tissues as Revealed by the Gaseous Content of Venous Blood, Am. J. Physiol. **73**:146 (June) 1925.
10. Drury, A. N., and Jones, N. W.: Observation upon the Rate at Which Edema Forms When Veins of the Human Skin are Congested, Heart **14**:55 (April) 1927.

of lymph drainage. Usually no edema is produced, but with prolonged application of heat edema may result. Dail and Moor[11] noted that in normal medical students the application of cold water or ice to any part of the body caused peripheral vasoconstriction, as shown by the plethysmograph. By means of the finger plethysmograph and skin thermocouple, Ghormley and Silverglade[12] found that systemic heating produced a greater increase in volume of the finger and in skin temperatures than did local conductive measures. They stated that by these devices it may be possible to determine the presence of a deficient circulation in arthritic patients.

Killian and Oclassen[13] found that mustard baths accelerated the peripheral circulation of the hand and foot, 74 and 51 per cent above the value for water alone at similar temperatures. They observed that cooling the surface of the skin of either the hands or the feet in water at 30 or 25 C. depressed the peripheral blood flow to a range of 40 to 25 per cent below normal.

In their plethysmographic studies Barcroft and Edholm[14] reported that after immersion in a water bath at 45 C. the average blood flow in the forearm was 17.6 cc. per hundred cubic centimeters per minute and the deep muscle temperature was 39 C., while at a water bath temperature of 13 C. the forearm blood flow was only 0.5 cc. per hundred cubic centimeters per minute and the deep muscle temperature was only 18 C. They[15] produced a rise in body temperature and increased blood flow in the forearm by immersing the feet and ankles in water at 44 to 45 C. while the test arm was kept in a water bath at 30, 32 or 35 C.

Bierman and Friedlander[16] produced decreases of as much as 24 degrees (F.) in deep muscle temperatures by applying ice to each side of the calf muscles for one to two hours. One of us (Wakim) and associates[17] found plethysmographically that artificially induced fevers in arthritic patients produced increases in the peripheral blood flow ranging from 25 to 294 per cent.

In 1930, Wright and Pemberton[18] reported that 75 per cent of their patients with rheumatoid arthritis had lower skin temperatures at the base of the finger nails than did normal persons under comparable conditions and that on exposure to cold the skin temperature decreased less than in normal persons. On the basis of these observations they suggested that disturbances in the peripheral blood flow were important factors in the rheumatoid syndrome.

Kovács, Wright and Duryee[19] found that the skin temperature of the fingers of 51 per cent of the patients with rheumatoid arthritis was below normal levels and that the capillary blood flow was slow and interrupted. Steinbrocker and Samuels[20] reported that 59 per cent of a series of 47 patients with rheumatoid arthritis showed vasospastic arterial disturbance, as compared with 33 per cent of a series of 75 patients with osteoarthritis. They

11. Dail, C. W., and Moor, F. B.: Effects of Heat, Cold and Other Stimuli upon Human Circulation, Arch. Phys. Therapy **19**:125 (March) 1938.
12. Ghormley, J. W., and Silverglade, Alexander: Circulation of the Joints of Chronic Arthritis, New York State J. Med. **39**:1489 (Aug.) 1939.
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16. Bierman, William, and Friedlander, Mac: The Penetrative Effect of Cold, Arch. Phys. Therapy **21**:585 (Oct.) 1940.
17. Wakim, K. G.; Krusen, F. H., and Elkins, E. C.: Effects of Artificially Induced Fever on the Circulation in Arthritic Patients, Arch. Phys. Med. **29**:274 (May) 1948.
18. Wright, Lillie M., and Pemberton, Ralph: The Peripheral Surface Temperature in Arthritis, Arch. Int. Med. **45**:147 (Jan.) 1930.
19. Kovacs, Joseph; Wright, I. S., and Duryee, A. W.: The Surface Temperature and the Minute Blood Vessels of the Skin in Arthritis, J. A. M. A. **100**:1018 (April) 1933.
20. Steinbrocker, Otto, and Samuels, S. S.: The Arterial Circulation of the Lower Extremities in Chronic Arthritis, J. Lab. & Clin. Med. **26**:974 (March) 1941.

concluded that the occurrence of arterial vasospasm was commoner in rheumatoid arthritis than in osteoarthritis.

Rowntree, Adson and Hench[21] reported that lumbar or cervical sympathectomy in cases of chronic infectious arthritis produced relief from vasomotor alterations, such as coldness, sweating and trophic changes, and increased the skin temperature of the fingers and toes. Abramson[22] suggested, from the evidence presented in literature, that patients with rheumatoid arthritis have signs indicating a diminished circulation, probably in the smaller vessels. On the basis of the poor response of arthritic patients to contrast baths, Woodmansey and associates[23] postulated that there exists an inherent defect in adaptability of the peripheral circulation which renders the patient more susceptible to rheumatoid arthritis. Naide, Sayen and Comroe[23] found that the peripheral vascular response of patients with rheumatoid arthritis follows a characteristic pattern of high basal vascular tone and easily constricted peripheral vessels. They consider this pattern to be responsible for the thin, atrophic skin, cold clammy hands and feet, cutaneous pigmentation, causalgia and hyperesthesia.

Edström and associates[24] kept patients with arthritis for a prolonged period in an environmental temperature of 82 F. with a humidity of 35 per cent. They found that the patients improved clinically and had an improved peripheral circulation as shown by rise in skin temperatures and venous oxygen saturation levels. These findings were maintained after discharge. They suggested that in such environment the peripheral vasospasm had been relieved.

Methods

Adult patients who were given contrast baths in the therapy of rheumatoid arthritis volunteered for this study. The 51 patients were divided into three groups of 20 patients each, some patients belonging to more than one group, as follows:

Group 1: These patients were given contrast baths to the upper extremities. This group included 8 men and 12 women, ranging in age from 25 to 71 years. The average duration of arthritis in this group was 7.5 years.

Group 2: These patients were given contrast baths to the lower extremities. This group included 9 men and 11 women, ranging in age from 23 to 58 years. The average duration of arthritis was 5.1 years.

Group 3: These patients were given contrast baths to the upper and lower extremities simultaneously. This group included 7 men and 13 women, ranging in age from 19 to 62 years. The average duration of arthritis was 4.5 years.

The observations were conducted in a thermostatically controlled room at a temperature of about 24 C. and a relative humidity of 40 per cent.

The subject reclined comfortably on the test bed for at least thirty minutes, after which skin temperatures were taken by means of the thermistor and oral temperature by clinical thermometer. Skin temperatures were taken over the dorsal surface of each wrist joint and at the anterior surface of each ankle joint before and after the contrast bath was given.

Measurements of blood flow were made by means of the venous occlusion plethysmograph with a compensating spirometer recorder. The plethysmographs were applied to each of the upper and lower extremities. The upper limb plethysmograph included the hand, forearm and elbow up to 2 inches (about 5 cm.) above the olecranon process. The lower limb plethysmograph included the foot and leg up to 1 inch (about 2.5 cm.) below the tibial tuberosity.

The collecting cuffs were placed just proximal to the plethysmograph and were inflated to a pressure of about 50 mm. of mercury for each determination of blood flow.

21. Rowntree, L. G., Adson, A. W., and Hench, P. S.: Preliminary Results of Resection of Sympathetic Ganglia and Trunks in 17 Cases of Chronic "Infectious" Arthritis, Ann. Int. Med. 4:447 (Nov.) 1930.

22. Abramson, D. I.: Vascular Responses in the Extremities of Man in Health and Disease, Chicago, University of Chicago Press, 1944.

23. Naide, Meyer, Sayen, Ann, and Comroe, B. I.: Characteristic Vascular Patterns in Patients with Rheumatoid Arthritis, Arch. Int. Med. 76:139 (Sept.) 1945.

24. Edström, Gunnar, Lindin, G., and Wrammer, T.: Investigations into the Effect of Hot, Dry Microclimate on Peripheral Circulation, etc., in Arthritic Patients, Ann. Rheumat. Dis. 7:176 (June) 1948.

The readings were recorded optically by use of the compensating spirometers, as explained by Berry and his associates.[25] Control blood flow values were established at the beginning of each period of observation, after the subject had been given sufficient time for adaptation to the plethysmograph and the surroundings (approximately thirty minutes).

In order to avoid unnecessary activity, after the control values had been established the patients were taken on a wheel chair to the hydrotherapy room where they were given the contrast baths.

The tubs employed for contrast bath therapy in the Section on Physical Medicine and in the arthritis service were used in this study. The tubs for the arms were of sufficient size for immersion of the entire forearm and elbow. The tubs for the foot bath were large enough to permit the leg to be immersed to within 4 or 5 inches (about 10 to 13 cm.) of the knee joint, depending on the length of the leg of the patient. The arm bath tubs were mounted on a central upright metal pipe so that each basin was easily moved from side to side. This arrangement enabled the patient to immerse the upper and lower extremities simultaneously. Hot and cold water sources were conveniently arranged so that the temperatures were maintained at the desired level. The total contrast bath period was thirty minutes. The extremities were first immersed in hot water at 106 F. The temperature was gradually increased to 110 F. for a period of ten minutes. Then the extremities were shifted into cold water at 60 F. for one minute and back to the hot water for four minutes. Alternating in this manner, hot and cold limb baths were given every four minutes and one minute, respectively, throughout a period of thirty minutes. In all cases the procedure began and ended with the hot water.

On termination of the contrast baths the patient's extremities were dried gently with bath towels and were covered with a sheet to minimize chilling. The patients were then returned to the observation room on the wheel chair. They were helped onto the test bed in order to minimize activity and to prevent changes in circulation not due to the contrast baths.

Skin temperatures, oral temperatures and heart rate were recorded after the contrast baths in the same manner as before. Within ten to fifteen minutes after completion of the hydrotherapy the plethysmographs were reapplied and blood flow determinations were again made at fifteen minute intervals for a period of forty-five minutes. Limb volumes were recorded after the termination of the observation.

Observations

In tables 1 to 4 inclusive, data obtained from 60 observations on 51 patients who were treated with contrast baths are presented. In order to avoid detailed reports of the circulatory changes of the individual extremities, average figures for the right and left extremities are given.

In group 1 (table 1), the patients who were given contrast baths to the upper extremities only, the total blood flow in the forearm before contrast baths ranged from 2.0 to 13.9 cc. per hundred cubic centimeters of tissue per minute, with an average of 8.3 cc. Fifteen minutes after the contrast bath the percentage increase of flow ranged from 38 to 196 per cent, with an average increase of 95 per cent. Forty-five minutes after the contrast bath the average percentage increase in blood flow was 39 per cent.

In group 2 (table 2), the patients who were given contrast baths to the lower extremities alone, the control total blood flow in the leg before the bath ranged from 2.0 to 8.6 cc. per hundred cubic centimeters of tissue per minute. The average control blood flow in the legs was 4.9 cc. per hundred cubic centimeters of tissue per minute. Fifteen minutes after the contrast bath the percentage increase of flow in the legs ranged from 16 to 155 per cent, with an average increase of 62 per cent. Forty-five minutes after the contrast bath the average percentage increase in blood flow in the legs was 45 per cent.

25. Berry, M. R.; Baldes, E. J.; Essex, H. E., and Wakim, K. G.: A Compensating Plethysmokymograph for Measuring Blood Flow in Human Extremities, J. Lab. & Clin. Med. 33:101 (Jan.) 1948.

TABLE 1. — *Changes in Blood Flow, Heart Rate, Skin and Oral Temperatures in Cases of Rheumatoid Arthritis After Contrast Baths to the Upper Extremities*

Chart Patient	Sex	Age, Yr.	Blood Flow, Cc. /100 Cc. Tissue: Before	After	Per Cent Change	Oral Temperature, °C.: Before	After	Change	Skin Temperature, °C.: Before	After	Change	Heart Rate Per Min.: Before	After	Change
1	F	45	10.3	14.2	38	36.6	37.2	+0.6	33.5	35.9	+2.4	60	72	+12
2	M	63	6.8	11.5	69	36.4	37.3	+0.9	.....	.....	....	80	86	+6
3	F	58	9.4	15.6	66	36.4	37.1	+0.7	33.1	35.3	+2.2	64	70	+6
4	F	31	6.3	14.6	132	37.1	37.5	+0.4	34.9	35.9	+1.0	96	100	+4
5	M	71	5.6	14.3	155	36.8	37.4	+0.6	33.5	35.2	+1.7	72	96	+24
6	M	61	5.8	10.3	78	37.0	37.5	+0.5	33.6	35.3	+1.7	88	96	+8
7	M	35	5.5	10.6	93	36.9	37.2	+0.3	34.5	35.2	+0.7	80	100	+20
8	F	46	13.4	26.2	96	37.2	37.5	+0.3	34.8	35.7	+0.9	80	100	+20
9	F	54	13.4	21.4	60	37.0	37.3	+0.3	34.1	34.9	+0.8	80	80	0
10	F	42	13.9	28.4	104	37.4	37.9	+0.5	34.4	36.2	+1.8	76	80	+4
11	F	40	9.7	22.6	133	36.9	37.3	+0.4	34.3	36.0	+1.7	68	76	+8
12	M	26	8.2	15.7	91	36.6	36.8	+0.2	32.9	35.7	+2.8	96	100	+4
13	F	30	8.3	14.4	73	36.8	37.4	+0.6	34.9	36.6	+1.7	80	80	0
14	M	25	8.0	23.7	196	36.9	37.2	+0.3	33.5	36.0	+2.5	64	82	+18
15	F	28	11.2	17.5	56	37.3	37.5	+0.2	34.5	36.0	+1.5	96	96	0
16	F	35	7.2	18.5	157	37.0	37.5	+0.5	34.6	36.2	+1.6	82	88	+6
17	M	64	10.7	18.1	69	37.1	37.9	+0.8	34.5	36.5	+2.0	74	96	+22
18	F	51	4.6	9.6	108	37.0	37.7	+0.7	31.6	35.1	+3.5	80	92	+12
19	F	40	6.9	12.3	78	37.0	37.2	+0.2	33.6	35.0	+1.4	80	96	+16
20	M	33	2.0	5.4	170	36.8	37.4	+0.6	33.3	35.9	+2.6	80	80	0

TABLE 2. — *Changes in Blood Flow, Heart Rate, Skin and Oral Temperatures in Cases of Rheumatoid Arthritis After Contrast Baths to the Lower Extremities*

Chart Patient	Sex	Age, Yr.	Blood Flow, Cc. /100 Cc. Tissue: Before	After	Per Cent Change	Oral Temperature, °C.: Before	After	Change	Skin Temperature, °C.: Before	After	Change	Heart Rate Per Min.: Before	After	Change
21	M	26	5.6	6.5	16	37.0	37.1	+0.1	.....	.....	....	64	68	+4
22	F	54	4.3	7.8	81	36.9	37.1	+0.2	.....	.....	....	68	70	+2
23	M	23	5.9	10.8	83	36.9	37.4	+0.5	.....	.....	....	76	100	+24
24	F	56	2.0	5.1	155	37.0	37.2	+0.2	.....	.....	....	82	90	+8
25	M	41	4.9	6.9	41	37.0	37.2	+0.2	34.5	35.3	+0.8	72	80	+8
26	F	31	4.2	9.5	126	37.0	37.2	+0.2	33.0	35.4	+2.4	80	84	+4
27	M	26	3.5	8.7	148	36.7	37.1	+0.4	33.1	34.0	+0.9	60	60	0
28	M	48	4.3	7.5	74	37.0	37.1	+0.1	30.3	35.9	+5.6	80	80	0
29	M	58	8.6	11.3	31	36.7	37.1	+0.4	34.3	34.3	+1.0	92	104	+12
30	F	44	3.1	7.1	129	36.5	37.0	+0.5	31.3	35.3	+4.0	80	120	+40
31	M	40	2.7	4.6	70	36.8	37.0	+0.2	31.1	35.5	+4.4	80	100	+20
32	F	38	6.3	8.9	37	37.0	37.4	+0.4	34.3	35.0	+0.7	80	100	+20
33	M	23	4.4	8.5	93	36.9	37.1	+0.2	33.1	35.0	+1.9	68	72	+4
34	M	48	6.7	7.9	18	36.8	37.0	+0.2	33.5	35.0	+1.5	80	80	0
35	F	50	7.1	9.5	34	37.0	37.4	+0.4	33.5	35.7	+2.2	72	76	+4
36	F	30	7.3	10.9	49	36.9	37.2	+0.3	33.0	36.5	+3.5	72	76	+4
37	F	35	4.7	8.8	87	37.0	37.2	+0.2	32.0	35.8	+3.8	80	80	0
38	F	35	4.8	8.2	71	36.9	37.2	+0.3	31.3	36.2	+4.9	88	94	+6
39	F	38	4.6	8.3	80	36.9	37.2	+0.3	30.3	36.0	+5.7	84	84	0
40	F	31	4.9	6.4	31	37.0	37.3	+0.3	34.8	36.0	+1.2	96	100	+4

In group 3 (table 3), the patients who were given contrast baths to the four extremities simultaneously, the control blood flow of the forearms before the bath ranged from 2.3 to 11.2 cc. per hundred cubic centimeters of tissue per minute, with an average flow of 7.1 cc. Fifteen minutes after the contrast bath the percentage increase of flow in the forearms ranged from 18 to 300 per cent, with an average increase of 100 per cent. Forty-five minutes after the contrast bath the average percentage increase of the forearm blood flow was 67 per cent. The control blood flow in the legs of this group before the bath ranged from 2.3 to 6.2 cc. per hundred cubic centimeters of tissue per minute, with an average flow of 4.3 cc. Fifteen minutes after the contrast bath the percentage increase of leg blood flow ranged from 12 to 145 per cent, with an average increase of 63 per cent. Forty-five minutes after the contrast bath the average percentage increase of leg blood flow was 55 per cent.

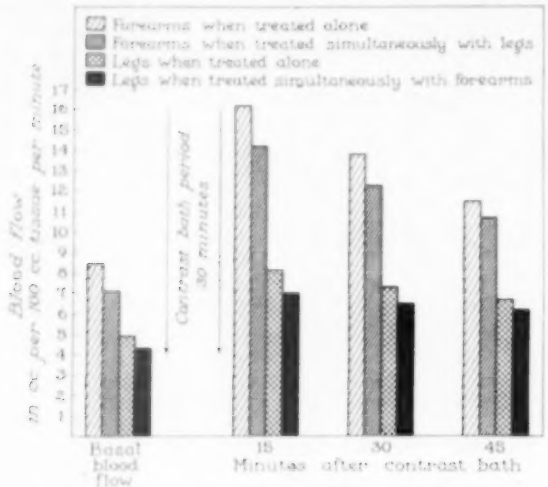
TABLE 3.—*Changes in Blood Flow in the Upper Extremities, Heart Rate, Skin and Oral Temperatures in Cases of Rheumatoid Arthritis After Simultaneous Contrast Baths to Both Upper and Lower Extremities*

Observation	Sex	Age, Yr.	Blood Flow, Cc./100 Cc. Tissue			Oral Temperature, °C.			Skin Temperature, °C.			Heart Rate Per Min.		
			Before	After	Per Cent Change	Before	After	Change	Before	After	Change	Before	After	Change
41	M	26	8.3	17.1	106	37.1	37.4	+0.3	34.0	35.1	+1.1	80	96	+16
42	F	31	7.0	15.3	118	37.0	37.3	+0.3	34.6	35.9	+1.3	80	100	+20
43	F	31	4.5	12.3	173	36.7	37.6	+0.9	33.7	35.3	+1.6	76	120	+44
44	M	44	4.0	7.3	82	37.0	37.1	+0.1	33.9	34.9	+1.0	68	70	+2
45	F	34	4.3	17.2	300	36.7	37.4	+0.7	32.2	35.3	+3.1	96	118	+22
46	F	61	5.6	15.8	182	37.0	37.7	+0.7	33.7	35.1	+1.4	64	72	+8
47	F	33	2.3	8.8	282	36.7	37.4	+0.7	30.2	32.7	+2.5	72	100	+28
48	F	41	6.7	12.8	91	37.0	37.4	+0.4	33.5	35.9	+2.4	76	100	+24
49	M	40	5.0	13.5	170	37.0	37.5	+0.5	33.7	36.3	+2.6	80	100	+20
50	M	59	8.7	12.6	45	37.1	37.2	+0.1	33.1	35.5	+2.4	80	120	+40
51	F	35	4.7	11.2	138	37.0	37.5	+0.5	33.1	36.6	+3.5	64	76	+12
52	M	49	9.4	12.3	31	36.8	36.8	0	34.4	36.0	+1.6	96	96	0
53	F	38	11.2	18.1	62	36.8	37.6	+0.8	34.8	36.0	+1.2	80	96	+16
54	M	59	8.6	18.9	120	37.0	37.4	+0.4	32.9	35.6	+2.7	76	86	+10
55	F	36	7.4	13.1	77	36.8	37.8	+1.0	34.3	35.9	+1.6	96	108	+12
56	F	19	9.6	17.1	78	37.4	37.7	+0.3	34.1	35.4	+1.3	76	84	+8
57	M	53	8.2	9.7	18	36.6	37.0	+0.4	32.6	34.8	+2.2	66	72	+6
58	F	58	9.9	22.3	125	37.1	37.5	+0.4	34.5	35.9	+1.4	60	68	+8
59	F	62	9.0	13.1	46	36.9	37.4	+0.5	33.9	34.8	+0.9	80	86	+6
60	F	47	7.3	16.4	125	37.1	37.4	+0.3	32.4	36.0	+3.6	80	80	0

The changes in blood flow are shown in the chart.

Skin temperatures taken at the wrists before the contrast bath in group 1 ranged from 31.6 to 34.9 C., with an average of 33.9 C. After the contrast bath to the upper extremities alone the average increase in skin temperature was 1.8 degrees C. The control skin temperatures at the ankles of group 2 ranged from 30.3 to 34.8 C., with an average of 32.7 degrees C. After the contrast baths to the lower extremities only, the average increase in skin temperature over the ankles was 2.8 degrees C. Control wrist skin temperatures of group 3 ranged from 30.2 to 34.8 C., with an average of 33.5 degrees C. After the contrast bath to the four extremities simultaneously the average increases in the wrist and ankle temperatures were 2.0 and 2.6 degrees C., respectively.

Increases in oral temperatures were observed in all cases following contrast baths. Group 1 patients, in whom the upper extremities only were treated, had an average increase of 0.5 degree C. in oral temperature. Group 2 patients, in whom the lower extremities only were treated, had an average



Changes of blood flow in cubic centimeters per hundred cubic centimeters of tissue per minute in cases of rheumatoid arthritis after contrast baths to the extremities.

increase of 0.8 degree C. in oral temperature. Group 3 patients, in whom the upper and lower extremities were treated simultaneously, had an average increase of 0.5 degree C. in oral temperature.

TABLE 4. — *Changes in Blood Flow of the Lower Extremities and in Skin Temperatures in Cases of Rheumatoid Arthritis After Simultaneous Contrast Baths to Both Upper and Lower Extremities*

Observation	Sex	Age Yrs.	Blood Flow, Cc. /100 Cc. Tissue			Skin Temperature, °C.		
			Before	After	Per Cent Change	Before	After	Change
41	M	26	5.2	7.5	44	33.4	34.8	+1.4
42	F	31	5.0	10.4	108	33.3	35.6	+2.3
43	F	31	3.1	6.4	106	33.7	35.7	+2.0
44	M	44	2.6	5.8	123	31.5	35.3	+3.8
45	F	34	3.2	5.4	69	31.5	35.1	+3.6
46	F	61	6.2	10.7	73	33.2	36.1	+2.9
47	F	33	2.3	3.9	70	28.2	34.9	+6.7
48	F	41	4.1	4.6	12	31.4	35.5	+4.1
49	M	40	5.5	7.9	44	33.1	35.3	+2.2
50	M	59	2.7	4.7	74	32.0	35.7	+3.7
51	F	35	3.1	7.6	145	32.1	35.4	+3.3
52	M	49	3.1	6.0	94	32.6	34.1	+1.5
53	F	36	5.3	6.4	21	33.1	35.1	+2.0
54	M	59	4.2	8.1	93	31.9	35.4	+3.5
55	F	36	4.7	8.1	72	33.7	35.5	+1.8
56	F	19	4.5	8.1	80	32.2	35.1	+2.9
57	M	53	5.0	5.9	18	32.9	34.7	+1.8
58	F	58	5.4	8.6	59	33.6	34.4	+0.8
59	F	62	4.5	7.7	71	34.1	34.8	+0.7
60	F	47	5.7	7.0	23	33.3	34.5	+1.2

In view of the asymmetric arthritic involvement in the cases studied, some variations in the blood flow and skin temperatures were observed. In general, the extremities with more extensive arthritis had higher skin temperatures and greater blood flows than the opposite extremities, which were not so extensively affected. In table 5 is presented a summary of skin temperatures and blood flow variations in the extremities showing this relationship in 11 patients.

TABLE 5. — *Direct Relationship of the Skin Temperatures and Blood Flow to the Degree of Inflammatory Reaction in the Involved Extremities*

			More Extensively Involved Extremity						Less Extensively Involved Extremity					
			Blood Flow, Cc. /100 Cc. Tissue			Skin Temperature, °C.			Blood Flow, Cc. /100 Cc. Tissue			Skin Temperature, °C.		
Observation	Sex	Age, Yr.	Before	After	Max. Per Cent Change	Before	After	Change	Before	After	Max. Per Cent Change	Before	After	Change
12	M	26	7.6	18.5	+143	32.8	35.7	+2.9	8.7	12.9	+48	33.1	35.7	+2.6
28	M	48	4.1	7.6	+85	29.5	35.5	+6.0	4.5	7.4	+64	31.2	35.3	+4.1
31	M	40	2.3	4.9	+113	30.4	35.5	+5.1	3.0	4.3	+42	31.8	35.5	+3.7
32	F	38	5.1	8.5	+67	33.2	34.5	+1.3	7.9	9.4	+19	34.8	35.1	+0.3
42	F	31	4.5	10.1	+124	32.7	35.6	+2.9	5.5	10.7	+95	33.9	35.6	+1.7
43	F	31	2.9	11.4	+293	32.9	34.7	+1.8	6.1	13.2	+116	34.5	35.7	+1.2
46	F	61	5.0	9.3	+86	32.7	35.9	+3.2	7.5	12.2	+63	33.7	36.4	+2.7
47	F	33	1.9	8.3	+337	29.8	35.0	+5.2	2.8	9.4	+236	30.6	35.5	+4.9
49	M	40	3.8	6.9	+82	32.8	35.3	+2.5	7.2	8.9	+24	33.4	35.4	+2.0
54	M	59	3.7	8.0	+116	31.5	35.4	+3.9	4.7	8.3	+77	32.3	35.4	+3.1
56	F	19	8.7	18.2	+109	33.4	35.1	+1.7	10.6	16.1	+52	34.8	35.7	+0.9

After contrast baths, the heart rate increased in most cases; in a few cases there was no change. In group 1, patients who were given contrast baths to the upper extremities only, the average increase in heart rate was 10 beats per minute. In group 2, the patients who were given contrast baths to the lower extremities only, the average increase in heart rate was 9 beats per minute. In group 3, patients who were given contrast baths to the upper and lower extremities simultaneously, the average increase in heart rate was 15 beats per minute.

Comment

Considerable variation in the peripheral blood flow has been observed in the group of 51 patients with rheumatoid arthritis. Stewart and associates[16] concluded that there is a linear correlation between the level of the peripheral blood flow and the average skin temperatures, so that where higher skin temperatures exist there is a higher peripheral blood flow. Our findings are in agreement with these conclusions.

Ghormley and Silverglade[12] observed that the peripheral circulation of arthritic patients gradually approached pretreatment levels within two hours after physical therapy. One of us (Wakim) and associates[17] noted that it took several hours before the blood flow gradually returned to normal values in arthritic patients treated with artificially induced fever. In the arthritic patients treated with contrast baths the peripheral circulation gradually approached normal values; however, in the observations made forty-five min-

16. Stewart, H. J.; Evans, W. F.; Haskell, Helen S., and Brown, Halla: The Peripheral Blood Flow and Rectal and Skin Temperatures in Hypertension, Am. Heart J. 31:617 (May) 1946.

utes after the termination of the hydrotherapy, the blood flows were still well above the control values.

The greater increase in heart rate when the bath was given to both upper and lower extremities simultaneously than when only one pair of extremities was bathed is attributable to the greater area of the body heated. This causes a greater proportion of warm blood to return to the heart and warm the pacemaker more efficiently.

Summary

The venous occlusion plethysmograph with the compensating spirometer recorder was used to study the effect of contrast baths on the peripheral circulation of 51 patients with rheumatoid arthritis. Patients were divided into three groups. Patients of group 1 were given contrast baths to the forearms, including the hands; group 2, to the legs, including the feet, and group 3, to both the forearms and the legs simultaneously.

Contrast baths were given at water temperatures of 110 and 60 F. (43.3 and 15.6 C.) beginning with an initial period of ten minutes' immersion in the hot water, alternating in the cold and hot water every one and four minutes respectively and ending with the hot water, making altogether a total of thirty minutes. This procedure produced a maximal average increase in peripheral blood flow of 95 per cent in the upper extremities when these alone were treated 62 per cent in the lower extremities when these alone were treated and 100 and 70 per cent, respectively, in the forearms and legs when all the four extremities were treated simultaneously. Forty-five minutes after the contrast bath to four extremities simultaneously there was still an average increase in blood flow of 63 per cent in the forearms and 55 per cent in the legs.

An average increase of 0.3 to 0.5 degree C. in oral temperature was observed as a result of contrast baths to the extremities. The temperature increase was greatest in those patients who received contrast baths to the four extremities simultaneously and least in those patients who received treatment of the legs only.

Higher blood flows and skin temperatures were observed in patients who had a low grade fever than in those whose body temperatures were normal.

The discussion of this paper will be published in a later issue of the ARCHIVES.

AMERICAN BOARD OF PHYSICAL MEDICINE AND REHABILITATION

The next examinations for the American Board of Physical Medicine and Rehabilitation will be held in Boston, August 26 and 27, 1950. The final date for filing applications is April 1, 1950. Applications for eligibility to take the examinations should be mailed to the Secretary, Dr. Robert L. Bennett, Georgia Warm Springs Foundation, Warm Springs, Georgia.

EFFECT OF HOT PACKS ON PERIPHERAL CIRCULATION *

EDWARD M. KRUSEN JR., M.D.
Fellow in Physical Medicine, Mayo Foundation

KHALIL G. WAKIM, M.D.
Section on Physiology, Mayo Foundation

URSULA M. LEDEN, M.D.
Fellow in Physical Medicine, Mayo Foundation

GORDON M. MARTIN, M.D.
and

EARL C. ELKINS, M.D.
Section on Physical Medicine, Mayo Clinic

ROCHESTER, MINN.

Hot moist packs have been used extensively to relieve the pain and discomfort of acute poliomyelitis. The mechanism of relief, however, is not clearly known. Watkins and Brazier[1] could demonstrate no specific effect of hot packs applied singly for twenty minutes on the muscular spasm of poliomyelitis. Hall, Schamp, Brown and Davis[2] observed that hot packs, applied to the flexor muscles of the forearm, reduced the force of voluntary contraction by about 10 per cent. They concluded that this effect was the result of sensory impulses produced by the packs. Hall, Muñoz and Fitch[3] found that the application of hot moist packs produced a slowly developing reduction in strength of contraction in the muscles of cats during electrical stimulation. They concluded that hot packs stimulated cutaneous receptors which reflexly evoked sympathetic vasoconstriction and reduction of blood flow in the muscle.

The purpose of this study was twofold: (1) to study the effect of hot packs on the peripheral circulation of man and (2) to compare the effectiveness of different methods of packing.

Method

Fifty sets of observations were performed in which temperatures of the skin and the blood flow in the extremities were studied. Temperatures were recorded from ten areas on the bodily surface by means of copper-constantan thermocouples. The thermocouples were applied to the first fingers of both upper extremities; to the first toes of both lower extremities; to the ankle, pretibial area, and the area over the gastrocnemius muscle of one leg, and to the wrist, ulnar and radial areas of one forearm.

Blood flow in the upper and lower extremities was determined by use of the venous occlusion plethysmograph with the compensating spirometer recorder.[4] The parts of the upper extremities sealed in the plethysmographs included the hand, forearm and a portion of the arm 1 inch (2.5 cm.) above the olecranon process. Each of the plethysmographs on the lower extremities covered the foot and leg up to 1 inch below the tibial tuberosity at the knee.

* Read at the Twenty-Seventh Annual Session of the American Congress of Physical Medicine, Cincinnati, Sept. 8, 1949.

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2. Hall, V. E.; Schamp, H. M.; Brown, G. E., and Davis, M. N.: Effect of Kenny Fomentation on the Strength of Voluntary Muscular Contraction in Man, Arch. Phys. Therapy 25:106 (Feb.) 1944.

3. Hall, V. E.; Muñoz, Elba, and Fitch, Barbara: Reduction of the Strength of Muscle Contraction by Application of Moist Heat to the Overlying Skin, Arch. Phys. Med. 28:492 (Aug.) 1947.

4. Berry, M. R.; Baldes, E. J.; Essex, H. E., and Wakim, K. G.: A Compensating Plethysmokymograph for Measuring Blood Flow in Human Extremities, J. Lab. & Clin. Med. 33:101 (Jan.) 1948.

After a period of adaptation to the surroundings and plethysmographs (about thirty minutes), the control blood flow was established for each extremity. The controls on cutaneous temperatures and the temperature of the air-conditioned room were also measured.

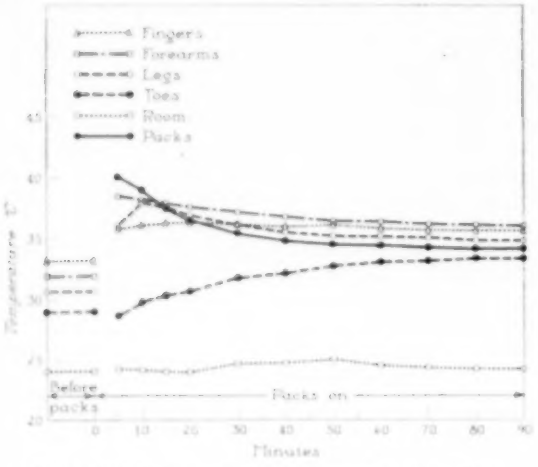
Double thicknesses of wool, cut to fit the parts, were moistened and steamed and then applied separately to cover completely each of the four extremities. They were covered with waterproof material and finally with dry blankets. In 17 determinations, similar packs were also used on the back and neck. In 5 determinations, packs were applied only unilaterally to one arm and one leg. Single sets of packs were applied in some determinations for periods of fifteen, thirty, forty-five and ninety minutes. In other determinations, packs were applied repeatedly every fifteen minutes for periods of thirty and forty-five minutes.

A thermocouple was inserted from the start into the pack of either the upper or the lower extremity to follow temperatures of the pack. Temperatures of pack, room and skin were recorded every five minutes in most determinations. In experiments lasting ninety minutes, these temperatures were measured every five minutes for twenty minutes and then every ten minutes till the end of the period.

The packs were removed at the end of the period and the blood flow in the extremities was again determined and compared with the control values on the basis of blood flow per hundred cubic centimeters of tissue.

Results

Temperatures of the Skin. — The chart presents typical curves of average



Curves of average temperatures after the application of hot packs.

temperatures. The recorded temperatures of the forearm are an average of the temperatures of the wrist, ulnar and radial areas of the forearm. The temperatures of the leg are an average of the temperatures of the ankle, pretibial and gastrocnemius regions of the leg.

Curves of average temperatures with packs applied to the back and neck as well as to the entire four extremities are essentially similar.

The interval of time (five minutes), as seen in the curves, between control temperatures and the test temperatures is the period required for the application of the packs. The packs were applied first to the upper extremities, while the packs to the legs were applied last. This probably explains the lag before the temperatures of the legs reach a maximum. The tem-

perature of the pack after about twenty minutes falls below that of the fingers, legs and forearms. However, it exceeds that of the toes, which were not included in the packs for the legs, although these packs extended down sufficiently to cover most of the remaining portion of the foot. The temperatures of the toes gradually rose during the test period while the packs were on. Temperatures of forearms and fingers decrease very gradually, while those of the legs fall somewhat more rapidly after reaching a maximum. At the end of one hour from the time of application of packs, all temperatures level off and remain moderately constant.

The average maximal increases of cutaneous temperature obtained for each type of determination are illustrated in table 1. The mean maximal increases of the forearms were exceptionally large for procedures 1, 6 and 11, which were, respectively, 7.2, 8.1 and 7.4 C. The importance of these large increases is reflected later in the report on the changes in blood flow.

TABLE 1. — *Mean Maximal Increases of Cutaneous Temperatures With Application of Hot Packs.*

Procedure	Duration, Minutes	Increase in Cutaneous Temperature, Degrees C.			
		Toes	Fingers	Legs	Forearms
1. Extremities	15	4.3	3.8	7.7	7.2
2. Extremities	30	3.4	3.8	7.1	6.2
3. Extremities	45	7.0	4.4	6.4	6.5
4. Extremities	90	4.5	3.4	7.7	6.7
5. Repetitive packs to extremities	30	3.1	3.1	8.1	6.8
6. Repetitive packs to extremities	45	7.8	7.6	9.2	8.1
7. Extremities and back	15	3.1	3.7	7.0	6.7
8. Extremities and back	30	4.3	4.0	8.2	6.5
9. Extremities and back	45	5.3	4.0	5.5	5.9
10. Extremities and back	90	4.0	6.1	8.5	7.0
11. Unilateral extremities (packed side)	30	3.3	6.1	8.2	7.4

Blood Flow. — The effects of hot packs on the blood flow were analyzed separately for the upper and for the lower extremities, since the vascular responses were somewhat different. Increases in blood flow were considered statistically significant if the *t* value, which is the quotient of the mean difference divided by the standard error of the mean, was equal to 2 or more than 2.

Significant increases in blood flow were found in both the upper and the lower extremities after most procedures of packing (tables 2 and 3). The largest increase in blood flow (5.0 cc. per hundred cubic centimeters of tissue) was produced in the upper extremities by packs applied every fifteen minutes for forty-five minutes (table 2). The smallest significant increase in blood flow (1.2 cc. per hundred cubic centimeters of tissue) was produced in the lower extremities by a single set of packs applied for fifteen minutes (table 3).

However, the increases in blood flow in the extremities were not significant in the following procedures. 1. In the upper and lower limbs after the application of one set of packs to the extremities for ninety minutes. The mean increases were 1.2 and 0.2 cc. per hundred cubic centimeters of tissue, respectively. 2. In the lower limbs after the application of one set of packs to the extremities, back and neck for ninety minutes. The mean increase was 1.4 cc. per hundred cubic centimeters of tissue. In this group, however, the increase in blood flow was almost significant. 3. In the unpacked upper and lower limb after the application of packs to the contralateral extremities for thirty minutes. The mean increases were 0.5 and 1.3 cc. per hundred cubic centimeters of tissue, respectively.

Comparison of Methods of Packing. — The differences in the increases of blood flow produced by different methods of packing were analyzed statisti-

TABLE 2. — *Effects of Hot Packs on the Blood Flow in the Upper Extremities.*

Procedure	Duration, Minutes	Observations	Blood Flow, Cc. per 100 Cc. of Tissue: Before Packs	After Packs	Mean Percentage Increase	Mean Increase Cc.	S. D.*	S. E.†
1. Extremities	15	10	4.4	8.6	95.4	4.2‡	0.92	0.31
2. Extremities	30	10	4.8	7.5	56.2	2.7‡	1.87	0.59
3. Extremities	45	12	5.9	8.8	49.2	2.9‡	1.77	0.51
4. Extremities	90	6	3.7	4.9	32.4	1.2	1.64	0.67
5. Repetitive packs, extremities	30	10	5.1	7.5	47.1	2.4‡	2.42	0.77
6. Repetitive packs, extremities	45	8	5.1	10.1	98.0	5.0‡	3.60	1.27
7. Extremities and back	15	10	5.5	9.4	70.9	3.9‡	2.04	0.64
8. Extremities and back	30	10	5.5	9.9	80.0	4.4‡	2.18	0.69
9. Extremities and back	45	10	7.2	10.6	47.2	3.4‡	2.45	0.78
10. Extremities and back	90	5	3.0	5.4	80.0	2.4‡	1.02	0.59
11. Unilateral packs								
A. Packed side	30	5	3.9	7.3	87.2	3.4‡	3.60	1.60
B. Unpacked side	30	5	3.4	3.9	14.7	0.5	1.97	0.88

* Standard deviation.
† Standard error of the mean.
‡ Statistically significant increase.

cally. With the application of packs to the extremities alone, the increase of blood flow in the arms after fifteen minutes of packing (4.2 cc. per hundred

TABLE 3. — *Effects of Hot Packs on the Blood Flow in the Lower Extremities.*

Procedure	Duration, Minutes	Observations	Blood Flow, Cc. per 100 Cc. of Tissue: Before Packs	After Packs	Mean Percentage Increase	Mean Increase Cc.	S. D.*	S. E.†
1. Extremities	15	10	2.1	3.3	57.1	1.2‡	0.97	0.31
2. Extremities	30	9	2.4	3.7	54.2	1.3‡	0.83	0.30
3. Extremities	45	12	2.4	4.5	87.5	2.1‡	0.91	0.26
4. Extremities	90	6	2.6	2.8	7.7	0.2	0.73	0.30
5. Repetitive packs, extremities	30	10	2.5	3.9	56.0	1.4‡	1.30	0.41
6. Repetitive packs, extremities	45	8	2.0	4.1	105.0	2.1‡	1.02	0.36
7. Extremities and back	15	10	3.5	5.1	45.7	1.6‡	0.99	0.31
8. Extremities and back	30	10	1.9	3.6	89.5	1.7‡	1.58	0.50
9. Extremities and back	45	10	3.1	4.8	54.8	1.7‡	1.18	0.37
10. Extremities and back	90	4	1.7	3.1	82.4	1.4	1.41	0.705
11. Unilateral packs								
A. Packed side	30	5	2.3	3.8	65.2	1.5‡	0.89	0.40
B. Unpacked side	30	5	2.1	3.4	61.9	1.3	2.30	1.03

* Standard deviation.
† Standard error of the mean.
‡ Statistically significant increase.

cubic centimeters of tissue) was significantly greater than after packing for either thirty minutes (2.7 cc. per hundred cubic centimeters) or forty-five minutes (2.9 cc. per hundred cubic centimeters) (table 4). This difference,

TABLE 4. — *Comparison of Mean Increases in Blood Flow When Packs Were Applied to Extremities for Varying Periods.*

	Arms				Legs			
Duration of packing, minutes	15	30	15	45	45	15	45	30
Observations	10	10	10	12	12	10	12	9
Mean increase of blood flow, cc. per 100 cc.	4.2	2.7	4.2	2.9	2.1	1.2	2.1	1.3
Difference between means, cc. per 100 cc.	1.5		1.3		0.9		0.8	
S. E.* cc. per 100 cc.	0.67		0.60		0.40		0.40	
t value†	2.25		2.17		2.25		2.00	

* Standard error of the mean.
† Quotient of the difference between means divided by the standard error.

however, was accompanied with a large maximal increase in temperature of the forearm in the fifteen minute procedure (7.2 degrees C.) and may indicate only that subjects in that series tolerated application of packs at higher temperatures.

With only the extremities packed, the increase of blood flow in the legs after forty-five minutes of packing (2.1 cc. per hundred cubic centimeters of tissue) was significantly greater than after packing for either fifteen minutes (1.2 cc. per hundred cubic centimeters) or thirty minutes (1.3 cc. per hundred cubic centimeters), (table 4). However, since the maximal increase in temperatures of the leg was not large (6.4 degrees C.), it is difficult to account for this difference on the basis of variations in heat applied and it may possibly represent a difference due to the method of packing.

When packs were applied to the neck and back in addition to the four extremities, no significant differences in the increases of blood flow were noted in either the arms or the legs after fifteen, thirty or forty-five minutes of packing.

A comparison of the increases of blood flow in the arms and legs with and without back packs revealed no significant differences.

When packs were applied to the extremities and changed every fifteen minutes, in general a greater increase in blood flow was produced than by the application of a single set of packs for the same total period, but this difference was not statistically significant.

The increases in blood flow in one arm and one leg which were packed unilaterally for thirty minutes were not significantly different from those produced by packing the four extremities for thirty minutes.

Comment

This study reveals that hot moist packs do produce rises in the temperature of the skin and increases in blood flow. The rises in the cutaneous temperatures are maintained above those of the control for at least one and a half hours, but in about one hour after application of packs the temperatures level off. It is obvious, however, that the increases in blood flow are not so well maintained. Sometimes between forty-five and ninety minutes after application, packs become relatively ineffective so far as effects on circulation are concerned. These data indicate that one set of packs should not be applied for longer than forty-five minutes.

In general, repeated applications of packs every fifteen minutes did raise the cutaneous temperatures and the blood flow to higher levels than did single applications for thirty and forty-five minutes, but the absence of a statistically significant difference in blood flow suggests that frequent changing of packs (every fifteen minutes) may be of no great value, as well as adding to

the problem of nursing care. However, repeated applications of packs at longer intervals were not included in this study.

Technically, it was found that packs produced their greatest effect if placed on the subject when they were as hot as could be tolerated (about 104 F. five minutes after application) and were fairly moist. Difficulty was encountered in getting satisfactory rises in temperatures of the skin or increases in blood flow if these conditions were not satisfied. Proper care should be exercised in applying fairly moist packs to prevent burning.

Whether the changes of circulation produced by packs are as great as those produced by other methods of heating is questionable. Wakim, Krusen and Elkins[5] found an average increase in the blood flow of the arms of 6.5 cc. per hundred cubic centimeters of tissue ten minutes after the patient's oral temperature had been raised to 101 F. by hot baths. This was a greater increase than that obtained by any method of packing in our study, in which the largest increase was 5.0 cc. per hundred cubic centimeters of tissue. The highest oral temperature attained with packing was only 100.3 F. Hipps and Crook[6] and Gurewitsch and O'Neill[7] have suggested the use of hot baths in the treatment of poliomyelitis. Of course, in certain circumstances, for example when the patient is in isolation, baths are not practical and packs may be the most satisfactory form of heating.

Summary

Fifty sets of determinations were made on the effects of hot packs on the temperature of the skin and on blood flow in the extremities. The following observations were made:

1. The temperature of the skin was definitely raised by packing. The temperatures of the packed portions fell gradually, leveled off about an hour after application of packs and were maintained above control values for at least ninety minutes.

2. Packing for fifteen, thirty and forty-five minutes produced significant increases of blood flow. However, this does not indicate that such applications employed only once daily would produce satisfactory therapeutic results.

3. After the application of a single set of packs to the extremities for ninety minutes there were no significant increases of blood flow in the arms and legs.

4. After the application of a single set of packs to the extremities, back and neck for ninety minutes there were significant increases of blood flow in the arms, but not in the legs.

5. When packs were applied to the extremities unilaterally, insignificant increases of blood flow were produced in the contralateral extremities.

6. Greater increases of blood flow in the legs may be produced by packs left on for longer periods.

7. The addition of back packs and repetition of packing every fifteen minutes produced insignificant differences in the increase of blood flow.

5. Wakim, K. G.; Krusen, F. H., and Elkins, E. C.: Effects of Artificially Induced Fever on the Circulation in Arthritic Patients, Arch. Phys. Med. 29:274 (May) 1948.

6. Hipps, H. E., and Crook, B. L.: Early Treatment of Infantile Paralysis, Arch. Phys. Therapy 25:403 (July) 1944.

7. Gurewitsch, A. D., and O'Neill, Margaret A.: Hot Baths in the Treatment of Early Infantile Paralysis, J. Pediat. 28:554 (May) 1946.

We are indebted to Dr. Joseph Berkson and Mr. Robert P. Gage for their helpful suggestions in the statistical analysis of the data and to Mr. Adrien N. Porter for his technical assistance.

A COMPARATIVE STUDY OF THE TEMPERATURE CHANGES PRODUCED BY VARIOUS THERMOGENIC AGENTS *

ALMA J. MURPHY, R.P.T., M.S.
W. D. PAUL, M.D.
and
H. M. HINES, Ph.D.
IOWA CITY

This report deals with a comparative study of the temperature changes produced by various thermogenic agents. Numerous reports have appeared concerning the thermogenic properties of short wave and microwave diathermy. Recent developments in engineering have made available radiations at several other wavelengths. In this study determinations were made of the temperature changes occurring in living and dead tissues as a result of irradiation with oscillating currents having a wavelength of 1,600 cm., 75 cm., 12.25 cm., 8.5 cm. and 3 cm. and the infrared portion of the electromagnetic spectrum. The temperatures were recorded at four different depths of tissue and compiled so as to determine the changes in temperature and the temperature gradients in the limb of living and of dead animals following irradiation with each wavelength.

Methods

This study was carried out on the hindlimbs of adult dogs ranging in weight from 13 to 19 Kg. The hair from the limbs was clipped closely in order to insure uniformity of insulation. Each live dog was utilized for a maximum of four irradiation treatments, and the limbs of dead dogs were irradiated only once. Two hours was allowed for temperature equilibration in the dead animals prior to irradiation. The temperatures of the tissues were determined by means of a thermocouple housed in a hypodermic needle and a Leeds-Northrup potentiometer.[1] The thermocouple needle was marked with enamel in order to determine accurately the desired depth of tissue. The temperatures were recorded at the external skin surface subcutaneous, 1.5 cm. and 3 cm. depths. All recordings were made in the same sequence in a small circular area and within a period of ninety seconds. The power output and mode of application required to produce the desired increase in tissue temperature were determined for each radiation frequency in preliminary trials. In the experiments in which both hindlimbs of an animal were used for study, a period of twenty to forty minutes were allowed to elapse between irradiation treatments.

1,600 Cm. Wavelength. — The cable of the short wave inductance diathermy generator was made into a pancake coil of three turns and separated from the animal's surface with a 2 cm. thickness of felt. A uniform reading of 12 units was set as the irradiation dose. A total of 32 experiments was carried out on living animals in which radiations were applied continuously for a period of twenty minutes and in which temperature measurements were made before and at the end of treatment. Eight experiments were made on living animals in which irradiation and temperature measurements were made in two consecutive periods of ten minutes each. Each animal in the dead tissue series was irradiated for two successive ten minute periods. Temperatures at the various levels were recorded before, at the termination of irradiation and every ten minutes thereafter until tissue temperatures had returned to approximately control levels.

75 Cm. Wavelength. — The 75 cm. generator delivered a power output of 8 kilowatts and was placed at a distance of 240 cm. from the animal. The surface of the animal except for one exposed limb was shielded from the radiations with copper screen. Experiments

* From the Department of Physiology and the Division of Physical Medicine, State University of Iowa.
* Read at the Twenty-Seventh Annual Session of the American Congress of Physical Medicine, Cincinnati, Sept. 7, 1949.

1. Tuttle, W. W., and Janney, C. D.: The Construction, Calibration and Use of Thermocouples for Measuring Body Temperatures, Arch. Phys. Med. 29:416 (July) 1948.

were carried out on 8 animals, 4 of which were anesthetized and 4 which were dead. The animals were irradiated for two consecutive periods of ten minutes each.

12.25 Cm. Wavelength. — A power output of 65 watts was employed in all of the 12.25 cm. microwave diathermy experiments. The 9 cm. director head was placed horizontally at a distance of 5 cm. from the surface of the limb. A total of 32 experiments was carried out on living animals in which the hindlimb was exposed to radiations for twenty minutes. In 6 experiments on living animals and 7 experiments on dead animals, the radiations were applied for two consecutive periods of ten minutes each and temperatures were measured at the end of each period.

8.5 Cm. Wavelength. — The director horn of the generator was placed at a distance of 20 cm. from the animal, and the generator was set to deliver 100 watts output. All animals were irradiated for two consecutive periods of ten minutes each. Fourteen experiments were carried out on living animals, and 7 experiments were made on dead animals.

3 Cm. Wavelength. — A 3 cm. pulsed wave generator with an average power output of 67 watts was employed at a distance of 40 cm. from the animal. The duration of the treatment periods and the interval of temperature measurements were the same as those employed in experiments with the 8.5 cm. wavelengths. A total of 16 experiments on living animals and 7 experiments on dead animals was made concerning the effects of 3 cm. radiations.

Infrared. — A 600 watt nonluminous infrared lamp was placed at a distance of 60 to 70 cm. from the limb to be treated. The limb was exposed to infrared radiation for two consecutive periods of ten minutes each. The pattern of temperature recording was the same as in the previously described experiments. A total of 14 experiments was carried out on living and 8 on dead animals.

Results

The temperature increases at the various depths resulting from irradiations with the several wavelengths are recorded in chart 1 and the table. It was found that greater increases in temperature occurred in superficial levels in 247 out of 266 experiments. In 240 out of a total of 266 experiments the least temperature increase was found at the 3 cm. depth. In the case of 75 cm. irradiations, the greatest increase in temperature occurred at the 1.5 cm. depth. However, irradiations with this wavelength resulted in greater elevations of temperature at the subcutaneous level than at the 3 cm. depth. The increases in temperature at the subcutaneous and 3 cm. levels are expressed as percentages of those found at the 1.5 cm. depth following irradiation with the several wavelengths (charts 2 and 3). From these data it can be seen that the shorter electromagnetic waves are relatively more effective for increasing the temperature in superficial tissues than in the deeper tissues and that the longer wavelengths are more effective for deep tissue heating. The same general relationship between wavelength and depth of heating was observed for both living and dead tissues. For all wavelengths studied in living animals, the greatest increment of temperature increase was found to occur during the first ten minutes of irradiation. The temperature increases in dead tissues were greater than those in living tissue following comparable periods of irradiation with all wavelengths. The temperature elevation in dead tissue exhibited a linear relationship to the time of irradiation. After irradiation, the temperatures of living tissues showed a tendency to have been equalized at all recorded depths. Only the tissues irradiated with the shorter wavelengths were inclined to show a higher temperature on the surface than in the deeper depths.

Comment

It is pertinent to point out that measurements of temperature increases alone are not necessarily indicative of the quantity of energy absorbed by tissues. A rise of temperature in any tissue merely indicates that the tissue in question has dissipated a smaller amount of heat to its internal and external

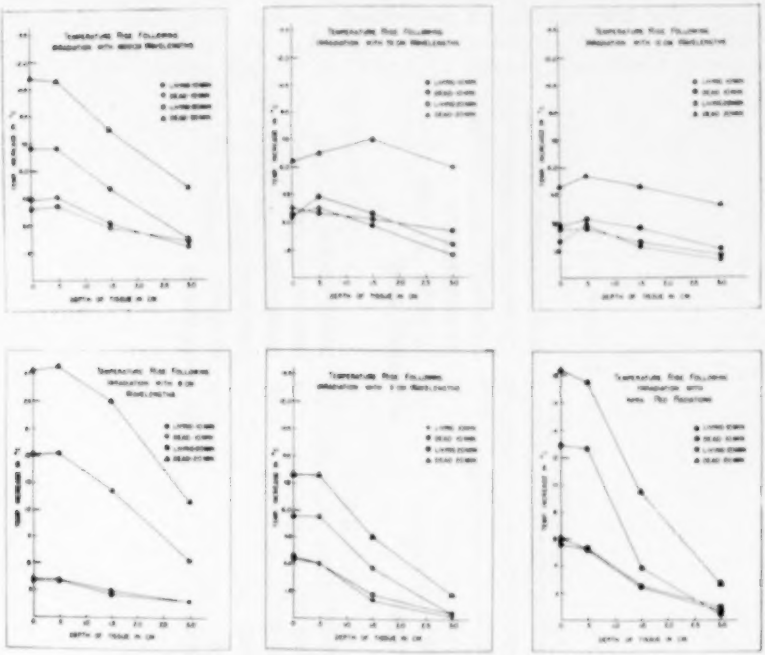


Chart 1. — Effect of irradiation on the temperature at various depths in the extremities of living and of dead dogs.

Temperatures of Living Tissues Irradiated with Electromagnetic Wavelengths.

Wavelength, Cm.	Tissue Depth, Cm.	Initial Temperature, °C.	Temperature Following Irradiation for 10 Min. °C.	Temperature Following Irradiation for 20 Min. °C.
1,600 cm.	Skin	36.9	41.7	40.7
	Subcutaneous	37.2	42.1	41.2
	1.5	38.6	42.0	41.5
	3	39.1	41.3	41.2
75	Skin	36.0	39.4	39.3
	Subcutaneous	36.2	39.9	40.6
	1.5	37.4	40.3	40.9
	3	38.6	39.8	40.4
12.25	Skin	37.0	39.5	39.7
	Subcutaneous	37.3	40.5	40.0
	1.5	38.6	40.6	40.6
	3	39.1	40.4	40.3
8.5	Skin	37.2	41.5	41.4
	Subcutaneous	37.5	41.7	41.5
	1.5	38.5	41.6	41.5
	3	39.4	41.3	41.4
3	Skin	36.8	40.1	40.2
	Subcutaneous	37.3	40.4	40.3
	1.5	38.4	39.5	39.8
	3	38.9	39.1	39.2
Infrared	Skin	37.1	42.7	43.1
	Subcutaneous	37.3	42.5	42.5
	1.5	38.7	41.1	41.2
	3	39.1	39.6	40.0

environment than that gained from local production and from its surroundings. The different levels of tissue depth at which the present temperature studies were made all present different gradient and vascular patterns. It is difficult, therefore, to determine where the greatest amount of energy absorp-

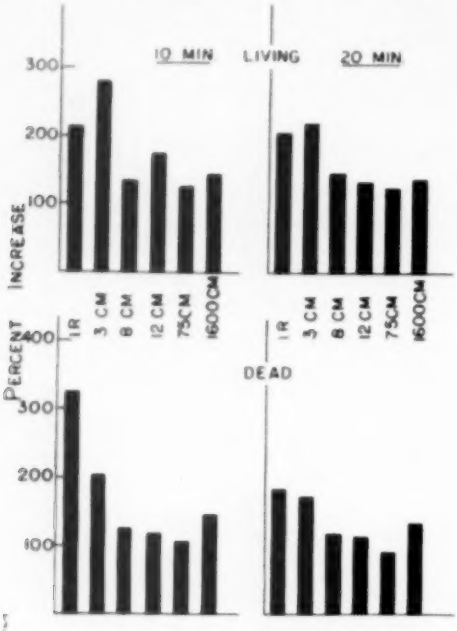


Chart 2. — Relative increases in temperature at the subcutaneous level expressed as percentages of those found at the 1.5 cm. level after irradiation with the several wavelengths.

tion occurs during the irradiation of living animals. This difficulty is emphasized by controversial reports concerning the nature of the changes in pattern of gradients resulting from irradiation with microwaves. Gersten and associates[2] reported 12.25 cm. microwaves cause a greater increase in the temperature of muscle than in skin or subcutaneous tissue. Other workers[3] have observed a greater rise in the superficial tissues than in the deeper layers during irradiation with this wavelength. Seguin[4] reported that greater superficial heating occurred with 3 cm. radiations than with 21 cm. waves. It is quite possible that much controversy could be avoided by more precise delineation of the terms "superficial" and "deep" tissues as well as standardization of experimental procedures.

Conclusions

The heating efficacy of six different wavelengths in living and dead animal tissues has been studied. Temperatures were recorded with a needle ther-

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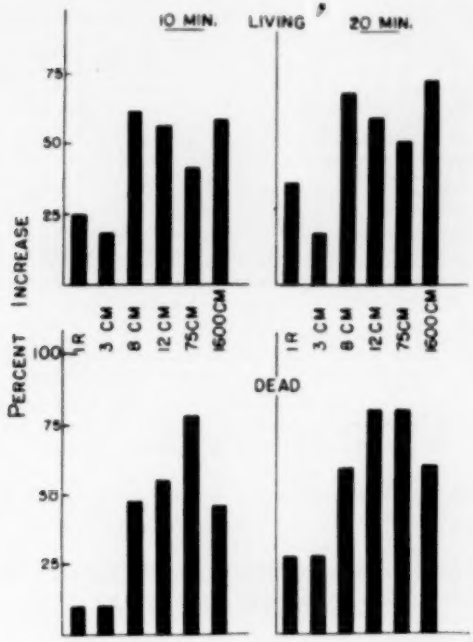


Chart 3. — Relative increase in temperature at the 3 cm. level expressed as percentages of those found at the 1.5 cm. level after irradiation with the several wavelengths.

mocouple at the surface, subcutaneous, 1.5 cm. and 3 cm. depths following two successive ten minute periods of irradiation.

The data collected relative to the temperature elevation following electromagnetic irradiation seem to justify the following conclusions:

1. Temperature elevations occurred when living and dead tissues were irradiated with 1,600 cm., 75 cm., 12.25 cm., 8.5 cm., 3 cm. and infrared rays.

2. A greater temperature elevation occurred in the superficial tissues than in the deeper tissues when irradiation was carried out with high frequency electromagnetic waves.

3. The increment of temperature change was greater during the first ten minute period of irradiation of living tissue than during the second ten minute period.

4. High frequency irradiation caused a greater increase in temperature in dead tissue than in living tissue during comparable heating periods.

5. The ratio between the temperature increase at 3 cm. depth to that at the 1.5 cm. depth is greater for the longer wavelengths than for the shorter wavelengths.

6. The ratio of the temperature increase at the subcutaneous level to the temperature increase at 1.5 cm. level is greater for the shorter wavelengths than for the longer wavelengths.

Discussion

Dr. Frederic T. Jung (Chicago): The authors have focused attention on a single variable, namely, the wavelength, and they have studied the influence of its variations upon the dependent variable, namely, the amount of heat liberated. They have tried to keep all other factors constant.

The advantages of working in this way are not widely enough appreciated, and, as a matter of fact, in clinical research it is

not always possible to control the other factors as well as they have been controlled in this instance. Also, the range over which the independent variable is allowed to move is often so narrow that conclusions are misleading. Within a narrow range the relation of the two variables may be linear, while in a broader range the relation may be seen to be curvilinear and to exhibit a minimum or maximum.

In the present instance it appears that within the range studied by the authors there lies an optimum wavelength. If that is correct, exploration of shorter and longer wavelengths cannot be expected to yield important new results, and an effort should be made to locate the optimum more precisely.

However, in dealing with a variety of diathermy apparatus it is hard to make sure that the wattages of the output are comparable, and the authors have noted this fact. Both the users and the manufacturers of diathermy apparatus would be glad to see somebody develop a reliable method of measuring and controlling the output.

Miss Murphy (closing): Dr. Jung's implied question concerning the effectiveness of a specific wavelength for optimal heating of tissues cannot be answered from this investigation. There is a tendency for the shorter wavelengths to heat the superficial tissues to a greater extent than do the longer wavelengths and the longer wavelengths to heat the deeper tissues to a greater extent than do the shorter wavelengths. The distinction between longer and shorter wavelengths cannot be made specifically from this study.

A question has been raised as to why temperatures were not recorded deeper than 3 cm. in the tissues. The leg of the experimental animal was not thick enough for the recording of temperature measurements at deeper depths. Moreover, additional temperature measurements would have been influenced by the greater time necessary to record a longer sequence of temperature readings.

AN AID TO WALKING FOR PATIENTS WITH SPASTIC HEMIPLEGIA

LEONARD J. YAMSHON, M.D.

Instructor Physical Medicine, College of Medical Evangelists;
Attending Physician in Physical Medicine and Rehabilitation, Birmingham Veterans Administration

LOS ANGELES

Ambulation by patients with hemiplegia differs from normal walking in the following particulars: 1. The pelvis on the hemiplegic side is elevated higher than normal during the swing phase of the step. 2. The center of gravity is shifted beyond the normal center when the body weight is borne on the normal foot and not so far as the normal center of gravity when the weight is carried on the involved leg. 3. The involved leg is maintained extended and is dragged forward through a circumducted arc. 4. There is a shorter time phase of weight bearing on the involved leg. 5. The step length of the affected lower extremity is shorter than normal. This results in an uneven, slow and labored gait. Progression is accomplished mainly by the normal leg. The patient appears to be running away from part of himself; in some cases he looks as if he were walking sideways.

In walking, a patient with hemiplegia first makes a step with the normal leg. This movement is almost a hop. The factors involved are a (1) sense of insecurity when weight is carried on the hemiplegic side; (2) failure of the center of gravity to shift over the involved leg, patient practically falling forward onto his normal leg, and (3) intensification of this propelling force by the stretch reflexes and the positive support reaction induced by contact of the involved foot with the ground.

The center of gravity is next shifted over the normal leg. The stretch reflexes are no longer the major factor in maintaining the involved leg extended. However, so long as the affected foot is in contact with the ground, myotatic reflexes give rise to a positive support reaction. The positive support reaction is manifested by extensor contraction. If the leg is dragged forward in a manner which produces muscle shortening, then stretch reflexes reenforce the positive support reaction. Therefore, it is necessary for the affected foot to break contact with the ground. To do this, the patient elevates his pelvis on the affected side and shifts his weight beyond the normal center of gravity on the unaffected side. If he has some means of support, such as parallel bars or a cane, he may actually lift the leg off of the ground. If he has no support, he will fall toward the normal side. In most cases, some degree of voluntary motion is present in the leg. The residual voluntary motion is most effective when extensor spasm is not stimulated. However, if the foot contacts the ground extensor spasm takes place. The affected leg is dragged forward through a circumductory arc by rotating the body around the normal leg which serves as a pillar of support.

While the foot drop brace has been of immeasurable value in overcoming these difficulties, another aid has been found to supplement its effectiveness. This additional aid consists in raising the sole and heel of the shoe worn on the normal foot. Elevating the sole and heel of the normal foot artificially changes the length of the leg. The normal leg is lengthened. The leg on the hemiplegic side can be lifted free of the ground by a slight shift of the body weight toward the uninvolved side. This action eliminates the positive support reaction and any associated stretch reflexes. As a result, residual voluntary leg flexion is more readily achieved. Another important accomplishment of the lift on the normal side is its effect on the centers of gravity. Since it is easier for the involved leg to clear the ground, the pelvis on the affected side requires less elevation during the step. Consequently, the center of gravity is not shifted so far when the body weight is transferred to the normal lower extremity. This gives the patient greater stability, and he is less dependent upon the external support. It reduces the time in the transition periods between walking in the parallel bars and ambulation with the aid of a cane. In many cases, canes can be eliminated; other patients will depend upon the cane mostly for psychologic security; others will place only slight pressure upon the cane.

During the step, when the body weight is shifted toward the hemiplegic side, the induced discrepancy in length of the legs tends to push the body weight toward the normal center of gravity. The uninvolved leg, because of its increased length, must be flexed to a greater degree than it normally would be flexed. This results in more body weight being carried by the involved leg, and the attaining of normal weight bearing is facilitated.

The swing-through phase of the involved leg during the step is accomplished with greater ease. It can be performed at a more rapid rate and with less interference by conflicting reflexes. The length of the step is increased. Shifting the body weight toward the normal center of gravity when weight is carried by the affected leg increases stability. The necessity for a quick step by the normal leg to regain balance is considerably diminished. The end result is a smoother, better balanced gait.

Summary and Conclusions

Elevation of the sole and heel of the shoe worn on the normal foot accomplishes the following effects: 1. It facilitates the breaking of contact be-

tween the ground and the involved foot thereby (*a*) diminishing or eliminating the positive support reaction and the stretch reflexes and (*b*) allowing for more adequate use of residual voluntary motion. 2. It facilitates ambulation by its effects on reflexes by decreasing the degree of shifting of the center of gravity beyond the normal when weight is borne on the normal leg. 3. It encourages weight bearing on the involved leg. 4. It makes for a more even step relationship between the normal and involved legs both in time and in length of step.

NEW HORIZONS FOR THE COUNCIL ON PHYSICAL MEDICINE AND REHABILITATION *

HOWARD A. CARTER, M.E.

CHICAGO

In 1925 the Council was brought into being by the Board of Trustees of the American Medical Association and called the Council of Physical Therapy. In 1938 its name was changed to the Council on Physical Medicine. Last year Rehabilitation was added. On the eve of the twenty-fifth anniversary of the first meeting of the Council, it is fitting to look into the future and examine the challenging problems placed before it.

Rehabilitation is a broad term, and if it is interpreted fully the specialty might embrace the entire practice of medicine. The Council looks upon it in a more restricted sense. It is the process of restoring handicapped workers and returning them as useful members of society at the earliest possible moment. Rusk refers to it as the third phase of medical care — that is, it takes the patient from the bed and reestablishes him in his former job or in a substitute one to accommodate for his handicap.[1] Patients in all walks of life — factory workers, office executives, farm hands and housewives — will benefit by sound advice in rehabilitation.

In the opinion of Krusen, there is a close relation between physical medicine and rehabilitation, but neither field will, or should, absorb the other; but many interconnections should be stressed. There are, for example, phases of physical medicine, as in the treatment of acute diseases by physical agents, which cannot be called rehabilitation, and there are phases of rehabilitation, as in the psychosocial readjustment of disabled persons, which cannot be called physical medicine.[2]

Although the term "rehabilitation" has been annexed only recently to the name of the Council, in my opinion its work has already included many of the concepts of rehabilitation, and the Council has considered and ruled on methods employed in that practice. The added functions deal with the psychosocial practices of readjustment and the methods of training to earn a livelihood. Thus the Council will be called upon to pass judicially on such products as muscle-training units, sight, speech and hearing rehabilitation equipment, prosthetic devices and methods of rehabilitation. Equipment for consideration and acceptance will be added which had previously been ruled

* Read at the Twenty-Seventh Annual Session of the American Congress of Physical Medicine, Cincinnati, Sept. 7, 1949.

1. Rusk, H. A.: Rehabilitation, J. A. M. A. 140:1286 (May 21) 1949.
2. Krusen, F. H.: Personal communication to the author.

to be outside the purview of the Council. The Council will also be expected to advise the Council on Medical Education and Hospitals relative to the contents of the curriculums of centers for residencies, to postgraduate instruction on the professional level and to schools for lay assistants.

An activity which found its home in the Council on Physical Medicine and Rehabilitation is the investigation of health resorts. The Council regards health resorts as functioning rehabilitation centers. Therefore the Council is most interested in their medical facilities, their departments of physical therapy and the willingness of the spa authorities to cooperate with the patient's family physician. This is a large and important field of medicine that requires development.

Hence with the addition of Rehabilitation to its name, the Council looks forward enthusiastically, on the threshold of its second quarter-century, to maintaining the standards already achieved and, indeed raising further the standards of physical medicine and rehabilitation and rendering a service to the profession which will do credit to the American Medical Association.

A NEW DIGIT MYOMETER *

An Apparatus for Measuring Small Gains of Finger Strength After Paralysis

LUTHER A. TARBELL, M.D.

Chief, Physical Medicine Rehabilitation Service, Veterans Administration Hospital

BATAVIA, N. Y.

In cases with hand or finger paralysis, as in hemiplegia, when function is beginning to return, the need exists for a simple apparatus to measure the amount of digital pressure and returning strength. In the return of function to the hand the flexors are movable considerably before the extensor group. This is probably due to a better established nerve track. (The flexor — sublimus and profundus — digitorum and the flexor longus pollicis regain their functions relatively early.) It is for this reason that the kanavel board and its modifications are very useful. The patient can partially flex the digits but needs help to extend them again. To measure this small early strength and its progress, the device for widest use must be simple, inexpensive and compact and yet must measure accurately the strength of delicate movement.

It is especially important for both the physician and the technician to be able to measure this motion early and accurately. Its prompt use helps to stimulate and motivate the patient. Early recognition of any slight gain in strength is very stimulating and encouraging to a patient who for weeks or even months has been unable to use his hand. He can be told the amount of that increase in strength.

I had previously used a commercial device which, although compact, was very delicate, expensive, and difficult to maintain in adjustment. After considerable experimenting, an apparatus has been chosen for its simplicity and

* Sponsored by the Veterans Administration and published with the approval of the Chief Medical Director. The statements and conclusions published by the author are a result of his own study and do not necessarily reflect the opinion or policy of the Veterans Administration.

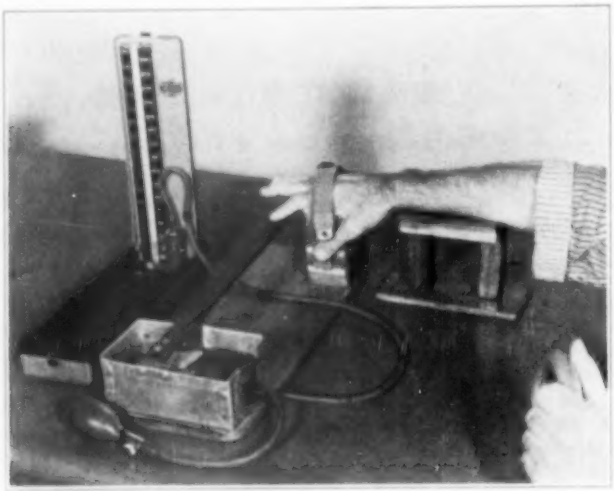
its ability to measure small amounts of energy and increase of digital strength. It can be easily made and accurately used by any technician, and because of its simplicity it does not easily get out of order.

Apparatus

Basically, the apparatus consists of (1) a metal (or wooden) box to hold the arm cuff of a sphygmomanometer and (2) a lever arm with a plate attached near the fulcrum. The lever arm is hinged at the box. The dimensions used were as follows: wooden base, 18 by 6½ or 7 inches; hand rest, 4½ inches high and 2½ by 4 inches in base area 4; box for cuff, 3 by 6 by 2½ inches; lever arm, 18 by 1 by ¼ inch, hinged at the outside edge of box; slightly concave metal disk approximately 1⅜ by 2¼ inches, to fit the middle of the box, attached on the under side of the lever arm approximately 1¾ inches from the fulcrum end. To hold the hand securely there is a strap over the top of the hand rest block and an arm rest the same height as the block.

Technic of Using

The apparatus is shown in the illustration. The patient should be in a comfortable position with his hand resting on the block and arm rest to



The digit myometer in use.

eliminate any measurement of arm or wrist pressure. The strength of the finger pressure is proportional to the increase in the height of the column of mercury:

20 mg. pressure produces a rise of 2 mm.
100 mg. pressure produces a rise of 10 mm.
200 mg. pressure produces a rise of 20 mm.

It was found that weights of 20 mg. increments placed on the end of the lever arm produces approximately the same rise in the height of the mercury column per increment. This was carried out with 20 mg. increments up to a total of 300 mg.

When the hand has sufficient strength to raise the mercury column 60 mm., the standard dynamometer may be substituted for measuring the continued progress in the strength of the hand if desired.

The cuff of the sphygmomanometer is rolled up, the edges tucked in and placed in the box. Air is pumped into the cuff until at contact the patient's digits are comfortably extended, or until the lever arm makes contact with the digits. A reading of the mercury is taken. The patient is then instructed to press down with his fingers. Another reading of the mercury level is taken and the increased height noted. As a motivating factor, the patient can also watch the movement of the lever arm. Motivation is especially important in such cases in order to have the patients exert themselves to accomplish maximum improvement.

In order to measure strength of the thumb, the hand should be turned to rest alongside the block with the thenar eminence resting on the block and the thumb on the lever.

This apparatus can also be used to provide resistance exercises for the digits, having the bag inflated to bring the lever arm to the proper position and pressing against the lever, using the air pressure for resistance.

Comparison with Ordinary Dynamometer

As an example of the use of this apparatus the following cases are cited:

A hemiplegic patient who had no initial strength in his fingers, after one week of treatment by resistive exercise on an elastic band hand exerciser could raise the mercury column to 10 mm. At the end of two weeks of treatment he could raise the same column to 20 mm and after the third week to 30 mm. At this time his hand was so weak that he was able to register no strength at all on the standard dynamometer. At the end of four weeks his strength had increased to the point that he could make pressure enough to register on the standard hand dynamometer.

In a second hemiplegic case, there was no increase in the height of the mercury column at the end of the first week of treatment. At the end of the second week he could raise it to 3 mm and after the third week to 10 mm. At this time on the standard dynamometer he could not get a reading above zero.

Summary

This digit myometer is a device for measuring accurately the muscle strength of very weak fingers. The apparatus is inexpensive, very simple to operate, not easy to get out of order. It is made for use with the ordinary mercury sphygmomanometer. It assists in motivating the patient.

28th Annual Session

SCIENTIFIC EXHIBIT SPACE

Requests for applications for scientific exhibit space in connection with the 28th Annual Session to be held at the Hotel Statler, Boston, Massachusetts, August 28 to September 1, 1950, are being received. Address all communications to the American Congress of Physical Medicine, 30 North Michigan Avenue, Chicago 2.

INTERNAL DERANGEMENTS OF THE KNEE JOINT

Their Diagnosis and Treatment *

HERMAN J. BEARZY, M.D.‡

University of Pennsylvania Student Health and Athletic Team Physician

PHILADELPHIA

Although the knee is one of the largest and strongest articulations in the body, it is subject to a number of injuries that occur under modern conditions of work and sport. Thorndike[1] and his group of the Harvard Athletic Medical Department recorded 864 injuries to the knee out of a total of 5,800 athletic injuries occurring in organized sports at Harvard University between the fall of 1932 and the spring of 1947. Many hazardous occupations such as lumbering, mining and present day means of rapid transportation have increased the incidence of trauma to the knee joint. Injuries to the knee, especially internal derangements, are common conditions for which a person seeks medical advice and rank second in frequency only to orthopedic conditions occurring about the foot and ankle.[2]

General Considerations

Anatomy. — The knee joint is a trochoginglymus joint, consisting of three articulations: two condyloid, one between each condyle of the femur and the corresponding meniscus and condyle of the tibia, and the third between the patella and the femur.[3] This compound type of joint allows rotation about a vertical axis as well as flexion and extension. Kuloski expressed the belief that this rotary departure from a true hingelike action, though slight, is in all probability the chief cause of internal derangements.

The integrity of the knee joint depends upon the strength and tone of the muscles and tendons around the knee, the strong articular capsule, the intrinsic ligaments and the bony architecture of the femur and tibia. The knee is further strengthened by the two cruciate ligaments within it.

The two semilunar cartilages, or menisci, are crescent-shaped fibrocartilages interposed between the condyles of the tibia and those of the femur. Each cartilage covers approximately the peripheral two thirds of the corresponding articular surface, and by its position serves to deepen the slight concavity of the articular surface of the tibia. During flexion and extension the cartilages move forward and backward to accommodate for the changes in the articulating surfaces of the femur. The external meniscus is loosely attached to the external capsule and has a certain amount of mobility which allows it to slip from between the ends of the femur and tibia, whereas the internal meniscus is so firmly bound to the capsule that it will rip or tear in its substance rather than break loose from its attachments when traumatized. This explains the high incidence of injuries to the internal meniscus.

* Read before the Pennsylvania Academy of Physical Medicine, Reading, Pa., March, 1949.

‡ Former Chief of Physical Medicine and Rehabilitation, United States Military Academy, West Point, N. Y., Former Fellow, Section on Physical Medicine, Mayo Clinic, Rochester, Minn.

1. Thorndike, A.: Athletic Injuries, Prevention, Diagnosis and Treatment, ed. 2, Philadelphia, Lea & Febiger, 1948.

2. Key, J. A. K., and Conwell, H. E.: Fractures, Dislocations and Sprains, St. Louis, C. V. Mosby Company, 1942.

3. Gray, H.: Anatomy of the Human Body, edited by C. M. Goss, ed. 25, Philadelphia, Lea & Febiger, 1949.

Examination of the Knee Joint

A complete physical examination should be performed to rule out such systemic conditions as osteoarthritis, tuberculosis, rheumatoid arthritis, tabes dorsalis and others. A thorough history should be taken to determine the method of injury, whether locking of the joint was present; whether it was due to a twist, a blow or a sprain; whether the patient was unable to walk immediately after the injury or whether he was handicapped until some one manipulated his leg. Roentgenograms with anterior, posterior and oblique views are essential to rule out pathologic change of bony structures. Arthrograms are useful to reveal tears of the semilunar cartilages, foreign bodies and hypertrophy of villi.

The following examinations should be performed on the injured knee and the findings compared with those on the sound knee before an attempt is made to establish a diagnosis.

Determining Range of Motion. — This is best performed with the patient in a supine position and the range measured with a goniometer. The degree of passive flexion and extension is measured in degrees and is expressed as such. The range of motion is the difference between the two measurements. In the normal knee, extension should be 180 degrees and flexion 45 degrees, producing a range of motion of 135 degrees.

Palpation for Fluid. — The leg is held in full extension and pressure is exerted downward on the suprapatellar pouch with one hand while the other hand exerts upward pressure over the infrapatellar area. This pressure over these areas will force any fluid present under the patella and to the anterolateral and anteromedial margins of the knee joint, where it produces a fluid wave palpable to the hands of the examiner.

Determination of Muscle Atrophy. — The circumference of the thigh should be measured with a tape measure about 8 to 10 inches above the patella and compared to the normal extremity. Muscle tone and strength can be determined by having the muscle work against some resistance. All measurements should be recorded at each examination. Atrophy of the quadriceps muscle group is one of the earliest and most serious complications following knee injuries.

Determination of Stability of Collateral Ligament. — The patient should be in a supine position with the leg fully extended if possible. One of the examiner's arms rests on the examining table and firmly grasps the injured knee at the level of the femoral condyles. The other hand holds the ankle and attempts to manipulate the knee in the coronal plane. The internal collateral ligament is tested by forcing the leg into adduction on the thigh. There should be little or no lateral motion when the collateral ligaments are intact.

Determination of Stability of Cruciate Ligament. — These ligaments are tested by what has been called the "drawer or shelf" test because the maneuvers resemble the in and out action of a drawer. The patient should be in a supine position with the knee flexed at a 90 degree angle. The examiner's forearm presses firmly against the lower tibia and with both hands grasp the leg just below the knee and attempts to manipulate the tibia back and forth. If the upper end of the tibia can be pulled forward, there is a tear or rupture of the anterior cruciate ligament; if the upper end of the tibia can be pushed backward, there has been damage to the posterior cruciate ligament.

External Derangements of the Knee Joint

In 1784 William Hay used the term "internal derangement of the knee joint" to include any alteration in the joint which prevented the condyles of the femur from moving freely in the groove formed by the semilunar cartilages and depressions of the tibia. Today the term internal, or mechanical, derangement includes all those conditions which interfere mechanically with the function of the joint, while the femur, tibia and patella usually remain intact. In the discussion of knee injuries I shall limit it to those common intraarticular lesions which are the result of primary and secondary trauma.

Injury to the Semilunar Cartilages. — Injuries or displacement of the semilunar cartilages are the commonest cause of internal derangement of the knee joint. In a series of 587 operations for internal derangement of the knee joint, Henderson, of the Mayo Clinic, performed 343 for lesions of the semilunar cartilages, and of these 90 per cent showed involvement of the internal cartilage. The basis for this frequency has already been mentioned.

Mechanism of Trauma. — The force necessary to injure a semilunar cartilage varies greatly. In contact sports such as football, it usually occurs as a result of a blow to the outside of the leg or knee. Such a blow may occur when the player is tackled or clipped and may produce a sudden forcible internal rotation of the femur on the slightly flexed and fixed tibia. If this position is maintained and extension of the leg is carried through, as will occur if the athlete is running, the inner condyle of the femur may press down on the internal meniscus and grip it. Unless the act of extension is terminated quickly, one of two things must happen: Either the internal meniscus is torn from its attachments and dragged toward the center of the joint or it must tear in its substance. The latter is what usually occurs, and the type of tear produced depends on the point at which it was traumatized. It may be the anterior, middle or posterior portion of the cartilage.[2]

Symptoms and Diagnosis: There is usually a history of a blow or a twist followed by a sensation of "something snapping or something giving way" in the injured knee. There is severe pain, swelling, spot or generalized tenderness, locking of the joint in approximately 75 per cent of the cases and a feeling of insecurity. A snapping sound and the ability to extend the knee after manipulation are pathognomonic in the presence of negative roentgen findings. Later the knee usually becomes stiff, more swollen and increasingly painful. Recurrent locking of the joint may ensue, and the irregularity of its occurrence makes steady employment practically impossible. Although there may be frequent attacks of such locking, the tendency is for the pain, swelling and period of incidental disability to decrease. The initial injury may not produce an actual tear of the meniscus, but as subsequent attacks occur, with catching and squeezing of the cartilage between the ends of the tibia and femur, a fracture is usually produced.

The commonest fracture is the loop or "bucket handle" type. This is a longitudinal tear in the middle portion of the meniscus, leaving the anterior and posterior margins, intact, so that the mesial portion of the cartilage is forced over into the intercondylar notch in the form of a loop. This loop, resembling a handle on a bucket, will obstruct the articulating surfaces of the tibia and femur and thus prevent full extension of the knee joint.

Conservative Treatment: Manipulation. — The knee should be manipulated if possible before much swelling has occurred. It may be performed with or without anesthesia, depending on the pain tolerance of the patient.

Ferguson[4] recommended the injection of 10 cc. of 1 per cent procaine hydrochloride solution into the site of acute tenderness. General anesthesia is required in some instances to complete the manipulation.

Technic. — In rupture of the internal meniscus the injured knee is flexed on the thigh and the thigh on the abdomen. The manipulator now grasps the patient's ankle in one hand, while the thumb of his other hand presses firmly over the anterior end of the internal meniscus. The tibia is then abducted on the femur, internally rotated and then suddenly forcibly extended. The manipulation, if performed properly, should release the fractured portion of the cartilage and allow the knee to go into complete extension. Manipulation should be repeated several times if the patient states that the knee "still does not feel right," and if this reassurance on his part is still lacking after several manipulations, the probabilities are that reduction has not taken place.

If reduction of the ruptured meniscus has been successful, the patient should be put to bed and the knee kept at full extension. Cold compresses or an ice bag should be placed over the injured knee for three or four hours

Fig. 1. — Application of ice compresses. (Army Signal Corps photograph.)

to minimize swelling and to relieve pain (fig. 1). Heat in the form of moist compresses or an infrared lamp is applied immediately after the cold therapy. Heat will promote relaxation of any muscle spasm and aid in the absorption of the exudate in and around the knee joint. Massage above and below the knee will also aid in the absorption of any exudate present, promote relaxation of spastic muscles and maintain muscle tone. Therapeutic exercises, such as quadriceps static contractions, should be started immediately to prevent atrophy of the quadriceps extensor muscles of the thigh.

In twenty-four to forty-eight hours, a posterior molded plaster splint should be applied, and it must be worn for four to six weeks or until pain and swelling have subsided. Quadriceps-setting exercises should be performed at least every ten to fifteen minutes while the cast is being worn, and a total of two to three hundred contractions of this powerful group of muscles should be performed each day. Many surgeons will bivalve the cast in eight to ten days to permit galvanic or faradic stimulation and massage of the

4. Ferguson, L. K.: Surgery of the Ambulatory Patient, Philadelphia, J. B. Lippincott Company, 1942.

quadriceps and hamstring muscles. Heavy resistance exercises such as those first described by DeLorme[5] should be performed as soon as the cast is removed and continued for a period of three to four months.

In the DeLorme program of heavy resistance exercises, the patient is asked to lift iron plates graded from 1¼ to 25 pounds each, attached to a special iron shoe or "boot" that is strapped to the patient's foot or shoe. The patient is seated on the end of an examining or massage table with his knees flexed to 90 degrees and is told to extend the knees with the boot and attached weights. The movements should be executed smoothly, rhythmically and without haste but not so slowly that mere holding of the weights is fatiguing. The person is instructed to lift no weight heavier than that which is maximum for ten repetitions. During an average exercise period, seven to ten series of exercises are performed with ten repetitions each, the total number of repetitions ranging from seventy to one hundred. Each exercise period should last for at least one-half hour and be performed once a day for five days a week. A record is kept by the physician and patient to show the total weight lifted and the increase in strength and circumference of the quadriceps extensor muscles. DeLorme has used this program in over 300 cases, and it has never produced chronic muscle strain nor failed to restore power to even the most atrophied muscles.[5]

Surgical Treatment: The surgical technic of a meniscectomy does not come within the scope of this paper. Numerous papers have been written describing the proper incisions and methods of exploration. However, I do wish to stress that the preoperative and postoperative care is as important for a good prognosis as the surgical technic itself.

Preoperative Care. — The preoperative measures include strengthening and increasing the tone of the muscles and intrinsic ligaments surrounding the knee joint by the graded therapeutic exercises that have already been described. Any abrasions and pustules if present on the skin must be cleared up before the incision is made into the knee joint. The utmost care must be used in establishing a diagnosis as to which cartilage is involved, for there is no single incision that allows free exploration of both cartilages.

Postoperative Care. — Liebolt and Stein[6] have outlined an excellent program for the postoperative care of meniscectomies.

First and Second Postoperative Days
Passive motion of the knee and lifting of the entire leg is attempted.
Third to Sixth Days
Active quadriceps setting exercises, bilateral. Knee and hip flexion.
Gravitational flexion of the knee by the physical therapist or physician. The knee is supported in the popliteal space and slowly raised. The knee flexes because of the weight of the leg.
Active flexion of the entire leg.
Sitting up exercises to prevent deconditioning of the entire body.
Seventh to Ninth Days
Active knee flexion, bilateral.
Mild forced flexion of the knee.
Gastrocnemius contraction with dorsal and plantar flexion of the ankle.
Increased active leg flexion, bilateral.
Raising the legs at the hip, feet together, performing abduction and adduction of the hips and legs.
Tenth to Fifteenth Days
Sutures are removed.

5. DeLorme, T. L.: Heavy Resistance Exercises, Arch. Phys. Med. 27:607 (Oct.) 1946.
6. Liebolt, F. L., and Stein, J. J.: Physical Reconditioning of the Knee Following Removal of Meniscus, Arch. Phys. Med. 27:413 (July) 1946.

Patient is permitted to walk under close supervision to detect any faults in the stride or gait. Five to ten minutes of walking with a rest period of thirty minutes is permitted on the first day of walking. The walking time is increased daily while the resting time is decreased.

Forced knee flexion.

Active knee flexion is continued.

On the twelfth day the patient should be sent to the physical therapy room, if one is available, to take exercises with the stationary bicycle, rowing machine and wall pulleys. I start the patient on the DeLorme resistance exercises at this time and have the patient continue them for many months.

Sixteenth to Twenty-eight Days

The patient is told to participate in such sports as golf putting, shuffleboard, bicycling and walking. If the incision is completely healed, swimming is permitted.

Goeringer[7] begins active straight leg raising on the first postoperative day and permits the patient to use crutches as soon as he is able to flex his knee to a 90 degree angle.

Injuries of the Collateral Ligaments. — Mechanism of Injury: The internal collateral ligament is usually injured by an abrupt force causing adduction

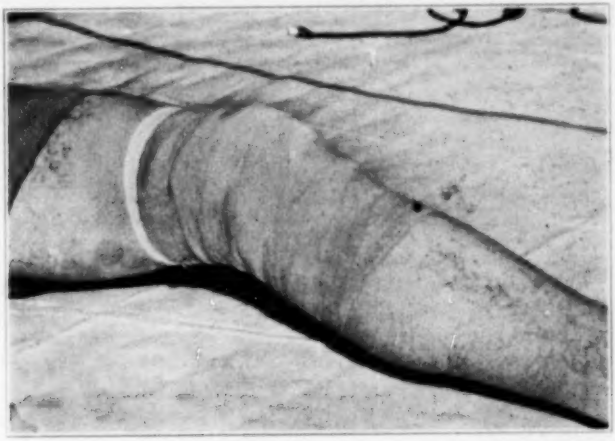


Fig 2. — Elastic compression bandage. (Army Signal Corps photograph.)

of the knee while the leg is fixed on the ground or by a sudden internal rotation of the thigh upon the fixed leg. The external lateral ligament is less frequently injured than the internal. In external lesions there is a history of forced abduction of the knee and a sudden external rotation of the thigh upon the fixed leg.

Pathology: The lateral and internal collateral ligaments of the knee are thickened portions of the joint capsule; hence any injury to these ligaments is accompanied with damage to the capsule and to the synovial membrane. The ligaments and the adjacent structures may be completely ruptured or merely stretched, with diffuse tearing of the fibers. Occasionally the ligament is torn from the attachment on the femur and tibia and a small piece of bone is evulsed with it, producing a sprain-fracture.

Diagnosis: There is a history of trauma to the knee followed by pain at the site of the lesion or throughout the entire joint, with a variable amount

7. Goeringer, C.: Personal communication to the author.

of disability. In mild cases, the patient may have normal stability of the collateral ligaments, but any attempt at weight bearing will produce severe pain. In a severe injury, there is complete disability and lateral mobility is usually increased.

Treatment: The patient should be put to bed and the knee supported with pillows. Cold compresses are applied immediately for a period of four to six hours. Heat is then prescribed to aid in the healing process and absorption of any effusion. Aspiration of the effusion may be necessary to relieve the tension and to remove any blood present in the knee joint. Blood should be removed immediately, because it acts as a mild irritant and may cause thickening and delayed restoration of motion in the joint.

In mild sprains, all that is necessary is immobilization with a pressure dressing or an elastic bandage and prohibition of weight bearing for three to six days or until pain has disappeared (fig. 2). After three to six days

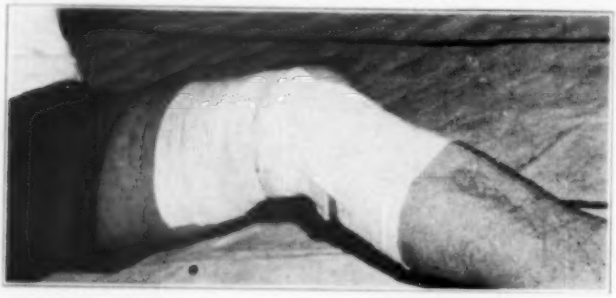


Fig. 2. — Modified Gibney adhesive support. (Army Signal Corps photograph.)

the patient is permitted to bear weight the aid of a cane and an elastic knee support or a Gibney adhesive strapping (fig. 3). Heat, massage and active resistance exercises should be started early and continued for several months after the patient becomes ambulatory.

In severe cases in which there has been a definite tear of ligament, the knee should be immobilized for a period of four to six weeks with a posterior molded plaster splint, and for sprain fractures the period of immobilization should be six to eight weeks.

Quadriceps exercises are carried on throughout the entire period of immobilization. If the surgeon will bivalve the cast, massage and heat may be given. Heavy resistance exercises should begin when the cast is removed and continued for four to six months thereafter.

Injuries to the Cruciate Ligaments. — Mechanism of Injury: Any trauma violent enough to rupture the crucial ligaments will do much damage to other structure in the knee joint. The anterior cruciate is tense when the knee is fully extended and prevents hyperextension at the knee and slipping forward of the tibia on the femur when the knee is in extension. It is injured by any force causing a forcible hyperextension at the knee or by forcible abduction and external rotation of the leg.

The posterior cruciate ligament is tense when the knee is flexed and prevents the flexed tibia from slipping upward on the femur. Injuries occur by any forcible flexion of the knee or by driving the flexed tibia upward and backward on the femur.

Pathology: The ligaments may be stretched, completely ruptured or avulsed with a bony attachment from the femur or tibia. When the posterior cruciate is injured the anterior is also usually injured.

Diagnosis: There is a history of a blow or twist to the knee followed by severe pain, swelling, marked disability and instability of the knee joint. The drawer test for cruciate stability will be positive. In injuries of the anterior cruciate ligament there is hyperextension of the knee, or if the tibia can be moved backward and forward on the femur when the knee is flexed, the posterior cruciate ligament is injured.

Treatment: Complete, prolonged immobilization in a position of about 15 to 20 degrees flexion for a period of two to three months is necessary to promote complete healing of the torn ligaments. At the end of three months, if the knee has shown some improvement, a metal knee cage should be worn for a period of two to three more months, if necessary, to promote complete healing of the torn ligaments.

Quadriceps-setting exercises should be started as soon as the cast has been applied and are continued until more vigorous exercises are prescribed. Active, active assistive and heavy resistance exercises should not be attempted until the knee shows some stability.

Summary

The knee joint is a strong and stabile articulation, but because of its exposed position it is subject to a great deal of trauma. The long bones that form the knee joint act as powerful levers, and consequently when some external force traumatizes the knee these bones place a tremendous strain on the structures that stabilize the articulation. The lesions produced may be rupture of the menisci, rupture or strain of the collateral or cruciate ligaments and, in many instances, a fracture or dislocation of the bony structures.

Preoperative and postoperative care in the form of heat, massage, therapeutic exercises and proper immobilization is just as important as any surgical technic to obtain a good stable knee. As in any program of physical reconditioning, a vital and integral part is played by the patient himself.

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MEDICAL NEWS

Personals

Dr. Khalil G. Wakim, of the Mayo Clinic and Mayo Foundation has been granted a leave of absence for three months, starting March 1 to take up an assignment at the National University of Syria, at Damascus. Dr. Wakim was requested to do this under the provisions of the Smith-Mundt Act whereby exchange of professors is effected between the United States and various other countries, for the purpose of giving assistance and advice in reorganization of the medical school at the National University.

Dr. W. A. Selle, formerly Professor of Physiology at the Medical School of the University of Texas, has been appointed Professor of Biophysics at the Medical School of the University of California. Dr. Selle has already assumed his new duties at the latter institution at Los Angeles. His many friends throughout the United States will be interested in this news, and knowing how successfully he labored in organizing the popular Galveston Springs Seminars on Physical Medicine, are confident that he will also put his shoulder to the wheel in serving the cause of Physical Medicine in California.

Dr. Donald A. Covalt, Associate Professor of Physical Medicine and Rehabilitation, and Eugene J. Taylor, Instructor in Physical Medicine and Rehabilitation, both members of the faculty of New York University College of Medicine, a unit of the New York University-Bellevue Medical Center, were among the speakers at the First Institute on Rehabilitation Problems in Puerto Rico. The conference was held at the School of Tropical Medicine in San Juan, Puerto Rico, February 1st to February 4th.

James F. Garrett, Ph.D., and Eugene J. Taylor, both of the staff of the Institute of Physical Medicine and Rehabilitation of New York University-Bellevue Medical Center, were among the United States representatives who attended the International Conference of Experts on the Educational Problems of Orthopedically Handicapped Children held in Geneva, Switzerland, from February 20th through February 25th.

Dr. Nicholas Mauriello has been reappointed chairman of the Committee of Physical Medicine and Rehabilitation of the Luzerne (Penna.) County Medical Society. Dr. Mauriello has also been appointed a member of the Commission on Physical Medicine and Rehabilitation of the Medical Society of the State of Pennsylvania.

Lieut. Col. John H. Kuitert (MC) has become chief of the physical medicine service at Walter Reed General Hospital, Washington, D. C.; since 1946 he has been chief of the physical medicine services at Fitzsimons General Hospital, Denver, and Tripler General Hospital, Honolulu.

Radio Station WTAM, the Cleveland Station of the National Broadcasting Company, has sponsored a series of four, one-half-hour broadcasts dramatizing the Physical Medicine Rehabilitation Program of Crile Veterans Administration Hospital, Cleveland, Ohio. Dr. Harry T. Zankel, Chief, Physical Medicine Rehabilitation at Crile was the Technical Supervisor of the Series.

American Society of Physical Medicine Officers and Committees for 1950

President — **Charles O. Molander**
President-Elect — **Miland E. Knapp**
Vice-President — **Frances Baker**
Secretary-Treasurer — **Max K. Newman**

Board of Governors

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Clarence W. Dail

As a result of a recent ballot of the voting members, the name of the organization will remain as it is, American Society of Physical Medicine.

Amputee Conference

The fourth annual amputee conference will be held April 20, 21 and 22, 1950 at the Kessler Institute for Rehabilitation, Pleasant Valley Way, West Orange, N. J. The detail of the schedule follows:

(Continued on page 174)

ARCHIVES of PHYSICAL MEDICINE

OFFICIAL PUBLICATION AMERICAN CONGRESS OF PHYSICAL MEDICINE

∴ EDITORIALS ∴

THE PHYSIATRIST AND ORTHOPEDIC APPLIANCES

Splints, braces, casts, protheses and other appliances are therapeutic measures for which the physiatrist should feel as confident in their prescription and use as he is for the other apparatus used in a Department of Physical Medicine. Other specialists have been allied with these measures for many years, however, the physiatrist because of his interests, training, and the very nature of his specialty should be more closely associated with their complete clinical management than anyone else. The physiatrist should have a working knowledge of the principles of the construction of the many different appliances and a thorough understanding of their application. He supervises ambulation and convalescence of patients from every service of medicine — the fracture and joint reconstruction cases from the orthopedic, the traumatic conditions from the surgeons, the patients with rheumatic diseases sent by the rheumatologists, the many types of nerve lesions from the neurologists, the poliomyelitis and cerebral palsy patients referred by the contagion and pediatric departments, and all the rest. He should be as familiar with the purposes and difficulties of a cast following a fracture as he is with the need of a walking caliper brace for a severe cerebral palsy patient. He should know when a brace has fulfilled its function for a patient with paresis and may be discarded as he is capable of adjusting or changing a cast in a rheumatoid arthritic. He should be able to manage and guide a patient who is destined to use an artificial appliance permanently and all that that implies.

These artificial aids have definite purposes which have become well established but occasionally are abused. Splints and casts, for example, are usually considered a means to immobilize a part temporarily or to maintain it in the most functional position. Too often the joints not bounded by the injury are included in the cast and are therefore not free for active motion. This would seem to be too obvious to require comment, however it occurs frequently enough to illustrate this abuse. The physiatrist is usually expected to correct these mistakes, and fortunately, in many instances, this is accomplished, however if he had better control of the splinting from the onset of the disorder, the treatments would be easier, less painful and less prolonged. Splinting also has other possibilities which are often neglected. They can be functional, that is, to maintain or improve a position that will be most useful. In traumatic conditions this is particularly effective, for example in the hand, an injury to the extensor pollicis, the thumb is splinted so that the muscle is shortened as much as possible; or if the flexors of the fingers are injured, the most satisfactory position is the application of a dorsal splint with the maximal flexion at the metacarpal phalangeal joints. In nerve injuries, splinting is most important to protect the paralyzed or paretic muscles. Sir Robert Jones, the great orthopedist, is quoted as saying that in a radial nerve degeneration, if the fingers and hand were allowed to be flexed only one time, sufficient damage would occur to cause irreparable injury. Not everyone agrees with Sir Robert's grave prognosis, but all admit

that continuous overstretching of paralyzed muscles delays the recovery and may result in residual weakness. It is the physiatrist who manages these patients with traumatic injuries to muscles and nerves — he anticipates the dangers of improper splinting and how this may lead to permanent pathological changes. He is trained to understand the action and function of muscles, the substitution movements and the physiological factors of exercise and rest. All of which places him in the unique position of being able to best appreciate what proper splinting can accomplish throughout the course of the traumatized part.

Braces are an essential part of the treatment for many conditions. The brace maker has improved his technical skill and contributed advancement by his ingenuity and training in the construction of the many types of braces but he has been handicapped by the lack of sufficient cooperation and supervision from the physicians. Braces must be designed to fit the individual patient, his disability, his psychologic makeup, his social status and the length of time they are to be used — factors which should be determined by the physician. When braces are to be worn permanently many questions are raised other than their mechanical construction, such as the patient's general condition, his opportunity to work, his comfort, the cosmetic effect, whether the brace will make it easier to care for himself and give him greater independence, the economic factor as to upkeep and the not insignificant factor of the wear on the patient's clothes. Jordan[1] summarizes the basic requirements of an efficient brace as follows:

1. correct medical indication,
2. scientific brace construction,
3. good workmanship,
4. high grade materials,
5. careful fitting,
6. intelligent use by the patient.

The physiatrist is the one physician who can be best informed on these items for all the different types of patients and by understanding and aiding in the control of the items one through five above, he can be assured of fulfilling his part in accomplishing item number six.

"Amputation is the beginning and not the end of treatment" was the apt statement of Watson Jones many years ago. This is particularly appropriate when a prothesis is contemplated. A prothesis demands the cooperative efforts of the surgeon, the bracemaker and the physiatrist. The duties of the physiatrist are numerous — he supplies the treatments to the stump postoperatively, he supervises the specific and detailed therapy that aid in mastering the use of the prosthesis, and he directs the program of rehabilitation. This phase of rehabilitation for a patient with an artificial prosthesis, as for patients with other appliances, is all inclusive. It embraces the physical restoration, guidance in the psychologic adjustment and whatever help may be necessary in vocational instruction to return the patient to as near normal activities as possible.

Evidence of renewed interest and progress in braces, prothesis and other appliances are present. New schools are being established throughout the country to train men for this technical work. In many instances the students are veterans who wear various appliances themselves. The Mellon Institute of Industrial Research supports fellowships on orthopedic appliances by means of the Sarah Mellon Scaife Foundation. For the past two years the Institute has held two symposia in Pittsburgh on orthopedic appliances. Brace

1. Jordan, Henry H.: Orthopedic Appliances, New York, Oxford University Press, 1939.

makers from the best shops in the country together with orthopedists and physiatrists were invited to attend. The Mellon Institute is working on plans for a course which would lead to a degree of Bachelor of Science in Orthopedic Mechanics at the University of Pittsburgh which will be set up under the joint auspices of the School of Medicine and the School of Engineering. The curriculum would include the general basic medical sciences of anatomy, physiology and pathology plus the clinical subjects as they pertain to orthopedic appliances. The course would also include metallurgy, elementary machine design and practical training in forging, welding, brazing, woodcarving, bench work, drafting, electroplating, leather finishing, tailoring, etc. Such training would supply a new type of technician — one who could correlate the medical and the mechanical problems. From this caliber of individual and with this background, new ideas and greater opportunities for research and investigation could be anticipated.

The Veterans Administration since World War II has done much to aid in the development of the orthopedic devices. Recently it was announced that teams of doctors and other specialists were to be established in 25 cities in the Regional offices of the Veterans Administration. These teams to operate for out patients and to be made up of an orthopedist, the chief of the Prosthetic and Sensory Aids Units, the chief of the Physical Medicine-Rehabilitation unit in the Regional office and a physical therapist. The local brace or prosthetic makers who are under contract with the Veterans Administration are also invited to attend the meetings. If necessary the clinic chief may also invite the clinical psychologist, psychiatrist, occupational therapist, corrective therapist, social service worker and foreman of the local Veterans Administration's brace shop. Such team work cannot but help the veteran to secure the best functional use of his appliances and should stimulate new possibilities in improving various devices.

The National Foundation for Infantile Paralysis eight years ago alloted large sums of money to two institutions to study the physiologic specifications for brace making with the emphasis on the fundamental principles of locomotion and muscle action. Mr. O'Connor, President of the National Foundation has promised that within two years a written monograph will be ready as a result of this work which will supply information on human locomotion and be a compilation of "basic principles upon which all brace making of the future may be founded." The completion of this study should supply knowledge that has never been available before and which should be of inestimable value.

The Association of Limb Manufacturers of America, a national organization of limb makers and brace makers, was founded during World War I. By their activity and cooperative efforts notable advances are being made in the development and improvement of the modern prosthesis. This group has fostered educational and scientific programs not only for their own members but for the amputees as well. During World War II the Surgeon General called several important conferences of the members of this organization to enlist their services in providing the best prostheses for the amputees. Their contributions have been very effective.

Our own American Congress of Physical Medicine has been aware of the importance of these appliances and has stimulated interest in this field. At the last annual meeting in Cincinnati, two lectures and demonstrations on braces were given in the instruction seminars. The scientific exhibits for several years at these annual meetings have stressed applications of various devices. Papers have been presented and articles have appeared in the

ARCHIVES OF PHYSICAL MEDICINE giving the latest information on the orthopedic appliances.

All of this is encouraging and indicates that these braces, splints, prostheses and other appliances are gradually attracting their rightful attention. To the physiatrist this has unusual significance. He can contribute a great deal to the greater development of this phase of medical care by assuming more responsibility for its complete clinical application. All of which should give new hope to the handicapped patients.

"MEDICINA FISICA".

The Argentinean Society of Physical Medicine at Buenos Aires announces the change of name of their official publication from "Kinesiologica" to "Medicina Fisica" (Physical Medicine). Thus another journal adopts the term, Physical Medicine. The editorial in the first edition under the new name is stimulating and expresses much zeal and confidence. In this same editorial it is nice to read the compliments bestowed upon our own Doctor Frank H. Krusen of the Mayo Clinic.

The ARCHIVES OF PHYSICAL MEDICINE welcomes the new name of this Journal of the Argentinean Society and sends them its very best wishes.

Medical News

(Continued from page 170)

Thursday, April 20th — Upper Extremity

9:00	A.M.	Registration
9:15-10:00	A.M.	Introduction to Amputee Problem
10:15-10:45	A.M.	Basic Surgery—Upper Extremity
11:00-12:00	A.M.	Hooks, Hands and Harnesses
12:00- 1:00	P.M.	Luncheon
1:00- 1:45	P.M.	Cineplasty and Cineplastic Prosthesis
2:00- 3:00	P.M.	Training Technics
3:00- 4:30	P.M.	Clinic — Arm Amputees

Friday, April 21st — Lower Extremity

9:00-10:00	A.M.	Basic Surgery — Lower Extremity
10:15-11:00	A.M.	Preprosthetic Care — Bandaging, Bed Posture, Early Exercises
11:15-12:00	A.M.	Prosthesis — Selection and Fit — Conventional BK and AK Prostheses
12:00- 1:00	P.M.	Luncheon
1:00- 1:45	P.M.	Fundamentals of Locomotion
2:00- 2:45	P.M.	Training Principles
3:00- 4:30	P.M.	Amputee Clinic — Discussion of Surgical, Prosthetic and Training Aspects

Saturday, April 22nd — Lower Extremity

9:00-10:00	A.M.	Surgery — Lower Extremity
10:15-10:45	A.M.	Gait Studies — Above Knee Amputee
11:00-11:30	A.M.	Tilting Table Prosthesis
12:00- 1:00	P.M.	Luncheon
1:00- 2:00	P.M.	Demonstration of Training Technics — Single AK, Double AK, Paraplegic Amputees, Amputee Clinic — Discussion of Surgical, Prosthetic and Training Aspects

Registration Fee $5.00
Registrar Mrs. Noel Dousman

Physical Medicine and Rehabilitation in the South

The Section on Physical Medicine of the Southern Medical Association presented an interesting and up to date clinical program at the Gibson Hotel, Cincinnati, Ohio, November 15, 1949.

During the meeting a motion was voted requesting the name of Section on Physical Medicine be changed to Section on Physical Medicine and Rehabilitation. The motion was approved by the Council of the Southern Medical Association.

The following officers were elected for the coming year:

Chairman: Walter J. Lee, M.D., Medical College of Virginia, Richmond, Virginia.

Vice-Chairman: E. M. Smith, Col., M.C., U.S.A. Chief, Physical Medicine Service, Army Medical Center, Washington 12, D. C.

Secretary: A. Ray Dawson, M.D., Chief, Physical Medicine Rehabilitation, McGuire VA Hospital, Richmond, Virginia.

VA Conference. — A conference of Chiefs of Medical Services from all VA hospitals and internists from regional offices in the Atlanta Medical Area was held at the VA Medical Teaching Group Hospital, Memphis, Tennessee, November 18-20.

The following area consultants participated in the Educational Program from various medical schools: Drs. Harrison Shull, Gastroenterology, Vanderbilt; Julian Ruffin, Gastroenterology, Duke; Robert Buchanan, Dermatology, Vanderbilt; Carter Smith, Cardiology, Emory; Wiley Forbus, Pathology, Duke; George D. Wilson, Physical Medicine, Asheville, N. C.; William A. Smith, Neurology, Emory; E. J. Stieglitz, Geriatrics, Washington, D. C.

Dr. George D. Wilson of Asheville, N. C., Area Consultant in Physical Medicine Rehabilitation

gave an illustrated lecture on Physical Medicine in the VA. Dr. Florence Mahoney, Chief of Physical Medicine Rehabilitation Service, VAMTG, Memphis, discussed Dr. Wilson's lecture and presented illustrations of improved technics employed on quadriplegics.

Dr. Robert W. Boyle, VA Rehabilitation Center, Fort Thomas, Kentucky, explained the purposes and aims of this center at Fort Thomas with especial attention as to requirements of patients for transfer for rehabilitation.

Partial Undergraduate Teaching Schedule in Physical Medicine and Rehabilitation, New York University

First Year Class Schedule

What is physical medicine and rehabilitation, Dr. Deaver, March 9, 1950.

Physical medicine and rehabilitation in the treatment of injuries, Dr. Russek, March 16, 1950.

How must we face the problem of chronic disease, Dr. Dacso, March 23, 1950.

The doctor's responsibility for treating the patient as an individual, Dr. Rusk, March 30, 1950.

Third Year Class Schedule

Clinical demonstration of the approach in low back pain, Dr. Kraus and Staff, April 14, 1950.

Electrodiagnosis, Dr. Harpuder, April 21, 1950.

The use of crutches and wheelchairs, Dr. Deaver, April 28, 1950.

Fundamentals of therapeutic exercise, Dr. Kraus, May 5, 1950.

Basic principles of physical therapy: thermotherapy, Dr. Bilik, May 12, 1950.

Basic principles of physical therapy: electrotherapy, Dr. Bilik, May 19, 1950.

Basic principles of physical therapy: hydrotherapy, Dr. Behrend, May 26, 1950.

Physical medicine and rehabilitation in fractures, Dr. Russek, June 2, 1950.

Physical medicine and rehabilitation of orthopedic disabilities, Dr. Russek, June 9, 1950.

Third and Fourth Year Lecture Demonstration for Third Surgical Division

Dr. Deaver and staff, 11:30-1:00, March 13, 1950.

Dr. Rusk and staff, 11:30-1:00, March 20, 1950.

Fourth Year Class Schedule

Physical medicine and rehabilitation in poliomyelitis, Dr. Deaver, March 14, 1950.

Physical medicine and rehabilitation for paraplegic patients, Dr. Abramson, March 21, 1950.

Rehabilitation of the deaf and hard of hearing, Dr. Daly, March 28, 1950.

Physical medicine and rehabilitation for patients with upper extremity amputations, Dr. Deaver, Mr. Daniel, April 4, 1950.

Physical medicine and rehabilitation for patients with lower extremity amputations, Dr. Covalt, Mr. Daniel, April 11, 1950.

Physical medicine and rehabilitation in tuberculosis, Dr. Covalt, April 18, 1950.

Physical medicine and rehabilitation in peripheral vascular disease, Dr. Rusk and Staff, Dr. Dacso, April 25, 1950.

Rehabilitation in compensation and industrial medicine, Dr. Lanza, Dr. Weeden, May 2, 1950.

Physical medicine and rehabilitation in chronic disease, Dr. Rusk, May 9, 1950.

New York Society of Physical Medicine

The regular monthly meeting of the Society was held March 1 and the following was the scientific session presented: "Clinical Electromyography: Physiologic Basis; Instrumentation; Diagnostic Value," by Drs. Gerald G. Hirschberg and Arthur S. Abramson, and discussed by Drs. Arthur Watkins, P. F. A. Hoefer, Sergei Feitelberg, and Joseph Moldaver.

German Periodicals in Physical Medicine

It is a welcome sign of recovery both in Western Germany and in Austria that physical therapy periodicals are appearing again under the leadership of physicians favorably known for their work in the pre-war period. The *Zeitschrift Fuer Physikalische Therapie, Baeder und Klimaheilkunde* has been appearing under the editorship of Prof. Dr. J. Kowarschik of Vienna and Prof. Dr. F. Scheminsky of Innsbruck every other month in Vienna since January, 1948; and now the *Archiv Fuer Physikalische Therapie* appeared for the first time in September, 1949 in Berlin under the editorship of Dr. W. Friedrich and Dr. H. G. Scholtz, both of Berlin. Some of the material appearing in our German contemporaries should make a welcome addition to the abstract columns of our own ARCHIVES.

BOOK REVIEWS

ULTRA- AND EXTREME- SHORT WAVE RECEPTION. Principles, Operation, and Design. By *M. J. O. Strutt*, D. Techn. Sc., Electronics Consultant, N. V. Philips Co., Ltd., Eindhoven, Holland. Cloth. Price, $7.50. Pp. 387 with illustrations. D. Van Nostrand Company, Inc., 250 4th Ave., New York 3, 1947.

In the preface the author points out that the object of this book is to offer peacetime applications of ultra- and extreme-short waves to individual reception problems. For the past sixteen years the author has been associated with the development of electronic tubes for short wave equipment ranging down to 1 cm. wavelength.

There is a wealth of information available for the medical research men who desire to have fundamental information on the physics of radio frequency energy. The book is highly mathematical from the standpoint of a physician although the author, a physicist, insists it has a minimum of mathematical treatment. The book is primarily for the engineer and as such is a good work. Physicians not well versed in mathematics will probably get very little out of it. On the other hand, engineers of electromedical appliances should find the volume of considerable value for their library.

PHYSIOLOGY IN HEALTH AND DISEASE. By *Carl J. Wiggers*, M.D., D.Sc., F.A.C.P., Professor of Physiology and Director of Physiology Department in the School of Medicine of Western Reserve University, Cleveland, Ohio. Fifth Edition, thoroughly revised. Fabrikoid. Price, $10.00. Pp. 1242, with 280 engravings. Lea & Febiger, 600 S. Washington Square, Philadelphia, 1949.

Wiggers' Physiology in Health and Disease has earned a well deserved reputation as a work of high order since its first publication in 1934. This fifth edition adds further luster to its laurels. This edition has been thoroughly revised and the author states the word "revised" incorporates the idea of again examining facts, statements, organization of material with the idea of bringing them into conformity with new discoveries as well as with new viewpoints in correlative medical education. Thus the text has been revised with the new material blended and amalgamated with the old to constitute a well connected narrative. Approximately one-third of the subject matter has been completely rewritten. More than 1,000 new references have been added and 60 of the 280 illustrations are entirely new.

Of special interest is the chapter on bioelectric phenomena which deals in part with the physiologic and clinical uses of action potentials as well as a discussion of the instruments used for their detection. Another valuable chapter discusses the physiologic basis of psychosomatic reactions. The physiatrist will find the chapter on muscular activity most valuable particularly the section dealing with prolonged bed rest of immobilization and convalescence. Another excellent chapter of marked interest to the clinician is the one on hypothermia and hyperthermia.

The volume is well written, easily read and is up to date. This book should be in the hands of every physiatrist and physical therapist.

PSYCHOSOMATIC MEDICINE: THE CLINICAL APPLICATION OF PSYCHOPATHOLOGY TO GENERAL MEDICAL PROBLEMS. By *Edward Weiss*, M.D., Professor of Clinical Medicine, Temple University Medical School, and *O. Spurgeon English*, M.D., Professor of Psychiatry, Temple University Medical School, Philadelphia. Second Edition. Cloth. Price, $9.00. Pp. 803, with 15 illustrations. W. B. Saunders Company, 218 West Washington Sq., Philadelphia 5, 1949.

On the flyleaf of this volume very appropriately is centered a quotation from Plato "For this is the great error of our day . . . . . that physicians separate the soul from the body." Many centuries have rolled by since and, as we now all realize, the quotation is as up to date today as it was over two thousand years ago. The two authors are offering an exceedingly well written, clear and well balanced presentation of the present aspect of psychosomatic medicine. They point out that about a third of the patients who come to a physician do not have any definite bodily disease to account for their illness; in another third the symptoms are in part dependent upon emotional factors, while those in the third group can be considered wholly within the realm of physical disease, such as migraine, asthma and essential hypertension but in their etiology and management the psychic factor may be of great importance. Thus a real understanding of psychodynamics is necessary in order properly to study the emotional life in relation to ill health. The authors present the general idea of the subject in the first two and last four chapters of the volume, while the other chapters in Part I deal successively with psychosomatic diagnosis, general principles, normal problems and special procedures in psychotherapy, ending with training in psychosomatic medicine. Part II is given over to the scholarly discussion of special applications to general medicine and the specialties in 16 chapters. A few pages are devoted to the psychosomatic aspects of physical medicine and on the basis of some interesting questions raised it is pointed out that there is a great need for psychosomatic study in physical medicine and that many problems exist to which such studies might contribute valuable information. There are many illuminative case histories throughout the text, ample

references for all the 24 chapters, a list of selected references of the general literature and a complete index. This is indeed a volume, the study of which will help every physician practicing general medicine or any of the specialties to get the basic concept of one of the most momentous developments of modern medicine.

REHABILITATION OF THE HANDICAPPED. A BIBLIOGRAPHY, 1940-1946. In two volumes. By *Maya Riviere*. With a foreword by *Holland Hudson*, Director, Rehabilitation Service, National Tuberculosis Association. Cloth. Price, $10.00. Pp. 998. National Council on Rehabilitation, 1790 Broadway, New York, N. Y., 1949.

The National Council on Rehabilitation has performed an invaluable service in sponsoring the compilation of this bibliography. Five thousand out of a total of 15,000 entries were finally selected to appear in these two volumes. Most of the entries have annotations. The material is extensively cross indexed according to a definite plan — which makes it possible to carry on an extensive study of any particular subject or merely to select the articles of particular interest. The period for the bibliography covers 1940 through 1946. Since 1947 the office of Vocational Rehabilitation has published a quarterly entitled "Rehabilitation Abstracts" which carries on this work. The second volume contains seventy pages on films, film catalogs and film sources which should be helpful information.

This book makes a very great impression because of the method of selecting, indexing and arranging this amount of material and in addition because it shows the scope and development of this vast field of rehabilitation.

This is a monumental work and should be of inestimable value for everyone who wishes to secure any and all references on rehabilitation in all its aspects during this six year period.

CLINICAL BIOCHEMISTRY. By *Abraham Cantarow*, M.D., Professor of Biochemistry, Jefferson Medical College, Formerly Associate Professor of Medicine, Jefferson Medical College and Assistant Physician, The Jefferson Hospital, Philadelphia, and *Max Trumper*, Ph.D., Commander, H(S), USNR. Lecturer in Clinical Biochemistry and Basic Science. Coordinator, Naval Medical School, National Naval Medical Center, Bethesda, Maryland. Fourth Edition. Cloth. Pp. 642, with 38 figures. Price, $8.00. W. B. Saunders Co., West Washington Square, Philadelphia, Pa., 1949.

This is the fourth edition of an excellent textbook which has been helpful to students and clinicians since the first edition appeared in 1932. It is a practical and understandable combination of physiology and biochemistry. The title of the book "Clinical Biochemistry" explains its purpose —rather than the technical consideration of the numerous biochemical laboratory procedures, the book correlates the biochemical changes in the various organs and systems with the normal and pathologic conditions.

The sections that have been revised include the renal and respiratory regulation of acid base balance; pigmentation metabolism in relation to jaundice; carbohydrate, lipid and protein metabolism; thyroid function; adrenal function; absorption and storage of iron; action of parathyroid hormone; renal physiology; and experimental diabetes. The new information concerning the chemical changes in shock, certain liver functions, the lower nephron nephrosis syndrome, potassium and its relation to diabetic coma, the alarm reaction and studies on adrenal function has been added.

The book has been brought up to date and should continue to enjoy a well earned popularity.

SHEAKER'S MANUAL OF HUMAN DISSECTION. Edited by *Charles E. Tobin*, Ph.D., Associate Professor of Anatomy, The University of Rochester School of Medicine and Dentistry. Second Edition. Cloth. Price, $4.50. Pp. 286, with 79 illustrations. The Blakiston Company, 1012 Walnut Street, Philadelphia 5, Pa., 1949.

The technic of human dissection is usually acquired with relatively little practice. The method followed is the regional method in which the design is to see everything that is to be seen in a single region of the body at one time. This manual is designed to facilitate and enhance instruction in gross anatomic laboratories. It has achieved a workable balance between the amount of procedure for dissection and descriptive text. It gives the dissection procedure for the entire body and yet keeps the dissected parts in as near their normal relationships as possible, so that relationships as well as individual parts can be studied. The instructor can adapt the plan of this manual to any sequence of regional dissection. In the second edition illustrations have been added and text descriptions have been simplified.

AN INTRODUCTION TO ANIMAL BIOLOGY. By *John B. Parker*, Ph.D., Professor Emeritus of Biology, The Catholic University of America, Washington, D. C., and *John J. Clarke*, Ph.D., Assistant Professor of Biology, Retired, The Catholic University of America. Third Edition. Cloth. Price, $4.00. Pp. 554. The C. V. Mosby Company, St. Louis, 1949.

One is accustomed to seeing textbooks of zoology filled with text that is tiresome and illustrations that hurt the eyes. This book is attractive in appearance, the text is very well written, and the pictures are clearly labeled. It deals with general zoology, as exemplified by protozoa and non-mammalian metazoa. It is intended for use with coordinated laboratory work so as to furnish subject matter for a one-semester course for students beginning the study of general biology. The glossary is, like most glossaries, perfunctory and inaccurate; for instance, *autonomic* is defined as "self control; independent." The rest of the book is remarkably free from errors, and there is a good index.

PRINCIPLES AND PRACTICE OF THERAPEUTIC EXERCISES. By *Hans Kraus*, M.D., Assistant Clinical Professor of Rehabilitation and Physical Medicine. Physician-in-Charge of Therapeutic Exercise, Institute of Rehabilitation and Physical Medicine, New York University, Bellevue Medical Center. Formerly Chief of Clinic, Physical Therapy, Vanderbilt Clinic, Columbia Presbyterian Hospital, New York City. Fabrikoid. Price, $6.50. Pp. 309, with 94 illustrations. Charles C Thomas, Bannerstone House, 301-327 East Lawrence Ave., Springfield, Illinois, 1949.

To those interested in physical medicine therapeutic exercise is an important subject although a very difficult one to write about. There is a great dearth of books pertaining to therapeutic exercise. None is entirely adequate, and this volume by Kraus is no exception although the author has made a fundamental and correct approach to the subject.

The book is divided into three parts. Part one outlines the fundamental working principles, and includes chapters on the clinical patho-physiology of muscle exercises, measurements, exercise technics, the treatment of pain and painful muscle spasm, the exercise prescription and supportive prescriptions. Part two is about the application of therapeutic exercises to various fields and is subdivided into three sections, namely: musculoskeletal conditions, the nervous system and respiration. Part three deals with general exercises with particular emphasis on convalescent exercises.

This volume is not a scholarly undertaking. The writing lacks clarity and is often most ambiguous. One also gains the impression of superficiality and over simplification of many important points. Many statements are dogmatic. This is not the type of book one expects from the pen of a medical scientist.

Certainly the author's casual definitions of spasm, spasticity, "hypertenseness" and rigidity will not satisfy the neuroanatomist, the neurophysiologist, or clinical neurologist. In fact, these definitions are vague, confusing and contradictory.

The term "de-contraction" would seem to be ill chosen. Anyone with training in physiology is familiar with Sherrington's concept of the reciprocal inhibition of muscular contraction.

It is difficult to understand why the writer favors novocaine "iontophoresis" (ion transfer) instead of the less tedious method of hypodermic injection for the relief of pain.

Kraus states that weight of the denervated muscle can be retarded markedly by the use of massage but this is not substantiated by the best available evidence. He also writes of motor point stimulation by an electric current to produce artificial exercise when the muscle cannot function voluntarily. If he refers to the denervated muscle there can be no motor point. Electrical stimulation is innocuous unless attention is given to the current form and duration of the stimulus and method of application.

In spite of the above criticisms the book has a great deal of merit. The author has approached the problem from the proper viewpoint. The subject matter is well outlined and an experienced physiatrist and physical therapist will find a great deal of valuable information. For teachers it should prove a valuable outline for teaching this very difficult subject. Its value as a textbook per se is doubtful. It is certainly not a book for the novice unless studied under careful supervision by an experienced clinician.

The author has consulted many books and articles and an excellent bibliography is given at the close of the volume. It is, however, unfortunate that Kraus does not indicate when he is making reference to some particular author. It would have been more profitable for the reader if the source of the references consulted were placed in a footnote of the page where the reference was made. In many instances one is not sure just whom he is quoting.

Experienced workers in the field of physical medicine will find this a book they will need for consultation.

ATOMIC MEDICINE. Edited by *Charles F. Behrens*, M.D., Captain M.C., U. S. Navy. Director, Atomic Defense Division, Bureau of Medicine and Surgery, Navy Department; Medical Officer in Command, Naval Research Institute, National Medical Center, Bethesda, Maryland. Fabrikoid. Price, $7.50. Pp. 416. Profusely illustrated with many tables. Thomas Nelson & Sons, Edinburg, New York, Toronto, 1949.

Here is a remarkably well written book and its publication should be a matter of great pride to its several contributors. It is also a unique book in that it is the first text written on the subject of atomic medicine. There are twenty-one chapters contributed by nineteen scientists under the able editorship of Behrens — each is a nationally known specialist in his field. Some of the subjects presented are: scope and general background of atomic medicine; the atom family and associated physics; the atomic bomb in action; ionizing radiations, fundamental biology of ionizing radiations; the pathologic anatomy of total body irradiation; the hematology of ionizing radiations; cumulative effects and permissable dosage limits of ionizing radiations; radiation illness; its pathogenesis and therapy; atomic disaster planning; tracer methods in the biologic application of isotopes; radioisotopes of medical interest other than radiophosphorus and radioiodine; the design and operation of laboratories employing radioisotopes in medical research; radiation effects of importance in dentistry; and research in atomic medicine.

There is an excellent and very valuable table of radioactive isotopes in the appendix at the end of the book. In addition there is an appendix of selected symbols, units and definitions which should prove to be most useful.

In his preface Behrens states that an earnest effort has been made to assemble such material

as is appropriate to the needs of the medical and allied professions and to present it as clearly as possible, steering a middle course between a presentation suitable only to specialists in the fields of radiation, biology, and physics, and one unduly elementary. In this the writers have succeeded admirably. The language used is simple, forceful and clear. Its simplicity of presentation does not detract one iota from its scientific value. The text is so written that the average physician should have no great difficulty in reading and following this fascinating story nor will it insult the intelligence of the physicist.

The book should be read by every physician first from the standpoint of his possible role in civilian defense; second, to keep informed of the developments already made by atomic energy in the field of medicine; and third, to learn of the future possibilities in this new era in both diagnosis and treatment.

This book has set a standard that will be difficult to equal and almost impossible to surpass. The publisher too has produced a book that is a credit to the publishing art.

INTRAMURAL AND RECREATIONAL SPORTS FOR MEN AND WOMEN. By *Norma M. Leavitt*, Ed.D., Associate Professor of Health and Physical Education, Illinois State Normal University; and *Hartley D. Price*, Ph.D., Professor of Physical Education, Florida State University. Cloth. Price, $3.00. Pp. 323. A. S. Barnes & Company, 101 Fifth Avenue, New York 3, 1949.

This book is oriented primarily for use of physical education students, teachers and workers dealing with normal individuals. There is sufficient detail of technic, however, so that it may be of value as a reference for physical, occupational and corrective therapists when sports are indicated for therapeutic and recreational purposes for hospitalized patients or those attending rehabilitation centers.

RÖNTGEN- UND RADIUMPHYSIK FUR MEDIZINER. By *Dr. Richard Glocker*, Professor für Röntgentechnik an der Technischen Hochschule Stuttgart. Cloth. Price, 19.80 German Marks. Pp. 275, with 168 illustrations. Georg Thieme Verlag, Diemershaldenstrasse 47, Stuttgart-O, 1949.

This book offers a well-rounded and up-to-date treatment of the subject of ionizing radiations. The opening chapter explains modern conceptions of the relation of matter to radiation. It is followed by sections on natural radioactivity, artificial radioactivity, the generation and application of roentgen rays, the measurement of ionizing radiations, the protection of personnel, problems of diagnosis and treatment (especially problems of deep therapy) by roentgen rays. The explanations of such subjects as radioactive isotopes, nuclear reactions and particle accelerators like the betatron are readable and illuminating. There is a wealth of accurate tabular information and good illustrations, as well as a bibliography and an index. The book deserves a place in every library used by students or practitioners of radiology.

ORTHOPEDIC NURSING. By *Robert V. Funsten*, M.D., Professor of Orthopedic Surgery, University of Virginia Medical School, and University of Virginia Hospital School of Nursing, Charlottesville, Va., and *Carmelita Calderwood*, R.N., A.B., Consultant in Orthopedic Nursing, National League of Nursing Education, New York. Formerly Supervisor, Orthopedic Service, Iowa University Hospital, Iowa City, Iowa. Formerly Clinical Instructor in Orthopedic Nursing, Children's Hospital, Denver, Colo. Second Edition. Cloth. Price, $4.25. Pp. 660 with 208 illustrations. The C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, 1949.

The first edition of this book has been reprinted 7 times during the war years, proving that it offered material which was welcome and useful. The second edition offers information on all phases of orthopedic principles and procedures which is almost encyclopedic, together with ample references of literature. The section on general features of orthopedic nursing offers a fairly extensive chapter on physical therapy, which, however, could stand a careful revision of its physics. In this edition new sections on nursing care of paraplegic cases and amputations have been added; emphasis is laid on convalescent reconditioning and early ambulation, and extensive information is furnished on nursing care of patients with poliomyelitis — fully 60 pages. The illustrations are generally well chosen and the style of the writing is readable.

MY GET-WELL TRIP 1949. By *Constance B. Crail*. Cartoons by Munro Leaf. Paper. Pp. 24, six by nine inches. For distribution without charge to polio patients in hospitals of pre-school and elementary school age. Publication No. 44 of the National Foundation for Infantile Paralysis, 120 Broadway, New York 5, N. Y., 1949.

PHYSICS OF THE 20TH CENTURY. By *Pascual Jordan*. Translated by Eleanor Oshry. Cloth. Price, $4.00. Pp. 185. Philosophical Library, Inc., 15 East 40th Street, New York 16, N. Y., 1944.

This book is a commendably smooth translation of an excellent non-technical review of modern "microphysics." The original author has refrained from following the established pattern of books on this subject. The patronizing air that some physicists adopt in attempting popular presentations of their subject is happily avoided, as is their equally irritating habit of alluding to a thing without explaining it. This book is heartily recommended to those interested in the subject. It is to be hoped that future printings will supply a few details concerning the author and the translator as well as an index.

MANUAL FOR ATHLETES. By *Edward F. Voltmer*, Ph.D., Head of Department of Health and Physical Education, Drake University, Des Moines, Iowa; and *Carl D. Voltmer*, Ph.D., Professor of Physical Education, College of the Pacific, Stockton, California. Cloth. Pp. 215, illustrated. Price, $3.00. The C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, Mo., 1949.

This is written for the use of the athlete, the prospective coach in training, and the coach now on the job. It does not pretend to be a profound or exhaustive treatment.

LEISURE AND RECREATION. A Study of Leisure and Recreation in Their Sociological Aspects. By *Martin H. Neumeyer*, Ph.D., Professor of Sociology, University of Southern California; and *Esther S. Neumeyer*, A.M. Revised edition. Cloth. Pp. 411. Price, $4.50. A. S. Barnes & Company, 67 West 44th Street, New York 18, 1949.

Recreational therapy is considered an important part of medical rehabilitation particularly for patients requiring prolonged hospital or institutional care. This medical application is only briefly discussed, however, so that the book is chiefly of interest to sociology students and teachers.

THE ADRENAL GLAND. By *Frank A. Hartman*, Ph.D., Research Professor of Physiology, The Ohio State University; and *Katherine A. Brownell*, Ph.D., Instructor in Physiology, The Ohio State University, Columbus, Ohio. Cloth. Pp. 581, with 72 illustrations. Price, $12.00. Lea & Febiger, Washington Square, Philadelphia 6, Pa., 1949.

The adrenals have assumed a dramatic and unrecognized role since the announcement of the effect of the cortical hormones on rheumatoid arthritis. Even at this early date a large amount of material has already appeared in the literature concerning the changes produced by the adrenal extracts on diseases other than arthritis. The importance of this latest knowledge of the adrenals on the many body functions cannot be overemphasized. The better understanding of the adrenals and their interrelationship with all systemic reactions may work as a most important revelation and open the way for a solution of many if not most of the bodily disorders. The possibilities seem almost unlimited.

This book amply demonstrates the integration of the adrenal glands with all the physiologic processes of the body. The relationship of the adrenals to carbohydrate, protein, fat and sulfur metabolism; to various physical agents such as heat, cold, light, roentgen ray, trauma and burns, to infectious and toxic products; to electrolyte and water exchange; to the other endocrine glands; and to the various vitamins are all thoroughly discussed. Consideration is also given to the influence of these glands on the functions of the circulatory, digestive, nervous, hematopoietic and genitourinary systems. Chapters are devoted to anatomy and embryology. Three chapters supply complete information on epinephrine and its pharmacologic and physiologic effects as shown by the numerous studies and experiments in all species of animals.

Addison's disease, Simmond's disease, the Cushing syndrome and a few other clinical conditions of adrenal insufficiency or hyperactivity are given consideration in the final chapters.

A bibliography of 124 pages completes the work. Most of the references pertain to animal experimentation. This is an index of the thoroughness with which the literature has been reviewed and also indicates the voluminous amount of investigative work that has been done to date.

IONIZATION CHAMBERS AND COUNTERS: Experimental Technics. Division V, Los Alamos Project, Volume 2 of National Nuclear Energy Series. *Bruno Rossi*, Professor of Physics, Massachusetts Institute of Technology, and *Hans H. Staub*, Professor of Physics, Stanford University. McGraw-Hill Book Company, Inc., New York, 1949. 243 pages, 138 illustrations.

This excellent book describes experimental technics used in the design of ionization chambers and other radiation detectors as developed during the war by scientists in the Los Alamos Laboratory of the Manhattan Project and later of the Atomic Energy Commission. Slightly less than one-half of the book is devoted to a detailed description of physical foundations of the working principles of ionization chambers, while the rest is devoted to a discussion of numerous other radiation detectors, such as beta-ray, gamma-ray, x-ray detectors, alpha particle detectors, detectors of neutron-alpha ray and neutron-proton reactions, Geiger-Müller and pulsed type counters. A thorough theoretical discussion of these various radiation detection devices is followed by a clear description of the experimental technic of measurement. Fine line drawings contribute much to the understanding of the problem discussed. The book is highly recommended to those interested in the construction and operating qualities of ionization chambers and radiation counters.

LIPIDOSES: DISEASES OF THE CELLULAR LIPID METABOLISM. By *Siegfried J. Thannhauser*. Chapter VII-A, Oxford Loose-Leaf Medicine. Paper. Illustrated. Pp. 214(3)-214 (595). Oxford University Press, Inc., 114 Fifth Avenue, New York 11, 1950.

This is a comprehensive and detailed presentation of our modern knowledge of fat metabolism and the related diseases by an outstanding authority. It is beautifully illustrated and printed and contains extensive bibliographic material. Publishing in book form will represent a noteworthy addition to medical literature.

PHYSICAL MEDICINE ABSTRACTS

Fibrositis and Psychogenic Backache. K. K. Sherwood, and Bruce Zimmerman.

Northwest Med. **48**:465 (July) 1949.

Fibrositic and psychogenic backache, that is, backache not due to disease of the vertebrae, vertebral joints or vertebral cartilage, is the most common and the least understood form of backache.

Physical therapy may give amazing relief to primary and secondary fibrositis. Heat of a mild degree administered by any acceptable manner results in temporary disappearance of symptoms. When this heat is followed by massage of gradually increasing force, the temporary relief is frequently permanent. Exercises designed to increase muscular strength, promote peripheral circulation and overcome muscle spasm should be incorporated as a part of the home or office program of physical therapy.

Physiologically continued tension will result in fatigue. Muscle fatigue has as its reflection in consciousness a dull aching.

Prognostically and therapeutically these patients group themselves into three divisions. The most favorable cases are those of short duration, whose symptoms are obviously a result of an unusual and severe environmental stress. These individuals have no preceding history of functional disability and, following a detailed telling of the story, perceive and accept the connection between the development of their unhappy environment and their tired, aching muscles.

The second group of patients are those whose duration, rather than weeks, is months or years. The history is, usually at least in its superficial cause and effect, apparent to an objective observer. These patients do not believe the significance of external cause resulting in an internal effect as applied to them. Logic will not convince them but will result in antagonism expressed as added assurance on their part that the etiology of their disease lies within their body and that you are insufficiently skilled to detect it. To such a type of patient one may appeal to the alleviating and analgesic properties of happiness. "Their backache will not be cured by increasing social activities, but, while still suffering, life may become more enjoyable." If one can secure acceptance of the analgesic value of happiness in these more chronic sufferers, gradual alleviation of their frustrating environment and consequently their symptoms occasionally occurs. These two groups represent the benign forms of nervousness, in which the major etiology is external to the patient.

The third group of these psychogenic backache patients includes those whose story reveals an inability existing throughout adult life to adjust and be happy in their surroundings. In these persons one is dealing primarily with a personality defect, a defect in the patient's personality and the external situation is merely the precipitating factor.

No discussion of psychogenic rheumatism is complete without emphasizing the role of psychiatry in its therapy.

Influence of Iontophoresis on the Permeability of the Excised Cornea. Charles Dyson.

Arch. Ophth. **42**:416 (Oct.) 1949.

Ion transfer of therapeutic agents capable of ionization has been shown to give high intracular concentrations of these substances. Since the epithelium of the excised cornea not only is virtually impermeable to electrolytes but also possesses a high degree of electrical resistance, the undamaged cornea would seem to be unsuited to the ion transfer of ions.

The appearance of a transient epithelial haze after the use of ion transfer has been noted by several investigators. This is usually reported as clearing within a few hours, but in 1 case a 4 mm. nebula persisted three weeks after treatment. These observations considered with the finding that damage to the corneal epithelium increases its permeability to penicillin lead one to suspect that the reported efficacy of ion transfer may be due to epithelial injury.

The excised corneal tissue is especially suitable for such studies because of its maintained functional integrity after the death of the animal. Ion transfer increases the permeability of the epithelium of the excised cornea to magnesium, chloride and levulose.

The Medical Treatment of Cerebrovascular Accidents. Frank K. Sewell.

Kentucky M. J. **47**:265 (July) 1949.

A great deal of the prognosis depends upon the patient. The better he has been able to adjust in the past the better the prognosis will be. The majority of patients will survive the stroke. Strokes occurring during sleep usually improve rapidly. Paralysis mostly sensory are more likely to result in a useless limb. The lower extremities return to function better than the upper. Paralysis with stereognosis preserved is a good omen. If pain appears it will persist and grow. If there is a hemiopsia with the paralysis, defects are likely to be severe. In general the higher the lesion the more grave the prognosis. To the patient the physician should be optimistic for many recover completely and are able to resume work. These old people have a fear of being a nuisance

around the house and a little overly optimistic encouragement often surprises the physician in its results. Absolute bedrest is essential. The patient should be turned frequently, to prevent hypostasis; postural drainage with aspiration of mucus is important. Well-meaning friends and neighbors should be excluded. The patient's questions should be answered as soothingly as possible. Gentle massage of the limbs with passive motion of the joints should be carried out as soon as the patient regains consciousness. As soon as voluntary motion returns the patients should be put through systematic exercise several times each day; warm baths, diathermy and massage may help. The length of time he is kept in bed depends upon the severity of the attack. Recovery will not be complete for about one year. During this time the patient must be reeducated in a way of life suitable to his individual capacities.

It is important to differentiate between thrombosis, hemorrhage, and embolism in order that the most satisfactory treatment may be followed. The important periods in treating cerebral accidents are during the stage of shock when the disease is advancing and the end is not in sight. During this period the shock should be treated. Then there is the period when the patient reacts and realizes the extent of his injury. Psychotherapy is invalable at this stage. The third important period is that of recovery during which supportive psychotherapy must be given. One of the most important recent advances in geriatric medicine is the recognition of the condition of multiple small strokes.

The Cardiovascular Effects of Acutely Induced Hypothermia. O. Prec; R. Rosenman; K. Braun; S. Rodbard, and L. N. Katz.

J. Clin. Investigation **28**:293 (Mar.) 1949.

Under the conditions of relatively constant body temperature which exist in warm blooded animals including man, the physiologic variations occurring in circulatory functions such as blood pressure, cardiac output, and circulatory rate are small. This relative constancy has led to the development of the concept of circulatory homeostasis. The changes in the cardiovascular system were studied in anesthetized dogs during acute hyperthermia induced by intense radiant heat and during the return of body temperature from 42 C. to normal. During the warming period the oxygen consumption increased markedly, rising to about 150 per cent of normal at 42 C. The cardiac output was progressively reduced. As a consequence the arteriovenous oxygen difference was increased. The blood pressure was maintained at relatively normal levels in the face of an apparent increase in the capacity of the vascular bed and a coincident decreased cardiac output, indicating an active vasoconstriction process. The heart rate increased progressively with hyperthermia and the right auricular pressure tended to fall. During the recooling period the oxygen consumption, respiratory rate and heart rate returned toward normal levels. The cardiac output and right auricular pressure continued to decline significantly even after the body temperature had returned to control levels. The blood pressure was maintained in most of the animals. No significant changes were found in the pulmonary arterial pressure. During hyperthermia the heart appears to be able to cope with the venous return. Our experiments therefore suggest that the circulatory changes occurring in acute hyperthermia depend upon an increased demand for blood by the tissues which leads to an increase in the volume of the vascular bed. Since the circulating blood volume and venous return do not increase proportionately and may even decrease, a marked reduction in cardiac output occurs. If the blood pressure and the circulation are to be maintained vasoconstriction must occur. Failure of the vasomotor centers to compensate for the progressively reduced cardiac output prepares the ground for peripheral vascular collapse.

Structure and Function of Muscle. Ruth M. Bowden.

Corres. Brit. M. J. **4627**:596 (Sept. 10) 1949.

I would be glad of an opportunity to correct two misunderstandings in the report (July 16, p. 160) of a paper given to the Section of Anatomy at the Harrogate meeting of the British Medical Association.

The pattern of reinnervation of human voluntary muscle varies with the nature of the lesion in the main nerve trunk and the severity of atrophic changes in the muscle itself. Thus, after a favorable lesion such as axonotmesis, the degree of reinnervation may be normal and maturation is of a high degree, although abnormal branching is seen at the motor endplates. Where there is scar tissue at the site of injury of the nerve some of the axons are obstructed and others may be misdirected. In such cases the intramuscular nerve trunks may contain both empty Schwann tubes and others containing nerve fibers in varying stages of maturation. Cutaneous sensory fibers fail to make functional reconnections with the muscle. If atrophic changes in the muscle are advanced and reinnervation is delayed, the axons are seen to have left the terminal Schwann tubes and they pass across muscle fibers in an attempt to form new connections. If the atrophic changes are irreversible the highest degree of reinnervation is of no avail.

Fibrillation action potentials are characteristic of denervated muscle fibers, they are wholly independent of voluntary effort. One of the early signs of reinnervation of muscle is the return of motor-unit action potentials. In cases which go on to successful recovery these motor-unit action potentials may precede probable voluntary contraction by ten to twenty days in cases of pure axonotmesis. In cases where the nerve has been sutured or there is a lesion in continuity with considerable intraneural scar they may precede voluntary contractions by several weeks or even two to three months. The appearance of a few motor-unit action potentials is no guarantee of

useful recovery; where such recovery is taking place successive electromyographic examinations of the muscle show an increasing number of motor-unit action potentials.

The Care of Hand Injuries.

Ohio State M. J. **45**:806 (Aug.) 1949.

The first-aid care of wounds of the hand is directed fundamentally at protection. It should provide protection from infection, from added injury and from future disability and deformity. The best first-aid management consists of the application of a sterile protective dressing, a firm compression bandage and immobilization by splinting in the position of function. No attempt should be made to examine, cleanse, or treat the wound until operating room facilities are available.

As soon as epithelization of burned surfaces is complete, directed active use and exercise of the hand is begun. Normal use of the hand is encouraged and voluntary exercise and appropriate occupational therapy prescribed.

Histamine Iontophoresis in the Therapy of Multiple Sclerosis. Harold A. Abramson.

New York State J. Med. **49**:1151 (May 15) 1949.

The treatment of multiple sclerosis by the intravenous administration of histamine, reported by Horton and his coworkers, has met with success in certain cases. Intravenous administration of this drug, however, has several disadvantages: the veins must be punctured repeatedly for months and possibly years; sterile equipment must be employed; a physician or other highly trained personnel must administer the treatment; it is expensive, and hospitalization is desirable. Previous investigations by the writer and his coworkers have shown that if histamine is introduced into the human skin by ion transfer (electrophoresis), the drug may remain in the pores of the skin for as long as two weeks. Histamine depots in the skin are readily demonstrated by using the positive pole over the depot to produce a secondary healing reaction after the wheal has disappeared, or, by using the negative pole, the drug may be withdrawn electrophoretically into the absorbent material. The histamine in the absorbent material may then be demonstrated by ion transfer into another site by wheal formation. Successful reports by Horton and his coworkers in the therapy of multiple sclerosis by the intravenous administration of histamine has led to a program of ion transfer with strong histamine solution. It had been shown previously that if histamine is introduced into the human skin by ion transfer, histamine depots are formed. Eleven patients with multiple sclerosis have been treated by ion transfer of histamine with sufficiently concentrated solutions and sufficient current density to produce both primary flushes during therapy and, in some instances, secondary flushes some hours later. The data indicate that histamine in the dose and form administered does not produce important changes in the oscillometric index in the arm but does produce a drop in the blood pressure, especially the diastolic pressure. In general, therapy increases muscular coordination, muscular strength, and improvement of vision. The advantages of the therapy proposed are the veins need not be punctured over prolonged periods of time; sterile equipment need not be employed; it is readily administered at home; it is inexpensive; hospitalization is not necessary, and it can probably replace intravenous therapy. On the basis of the data presented thus far, it is believed that prolonged ion transfer with histamine, possibly combined with vasodilators by mouth, provides a greatly simplified form of therapy with good therapeutic possibilities.

The Sun and the Skin. J. M. Hitch.

North Carolina M. J. **10**:299 (June) 1949.

The beneficial effects of the sun have long been stressed. So many scientific and popular expositions of the virtues of sunbathing have been published that those individuals who fail to acquire a deep mahogany color during the summer are now looked upon as not only unsophisticated but downright queer. For most individuals the acquisition of a seasonal tan through repeated subjection to small attacks of sunburn, and even the daily exposure of large areas of the body to the sun throughout the year are probably beneficial. However, an appreciable number of persons, for one reason or another, are adversely affected by the rays of the sun and by certain artificially produced wavelengths. It is this group which is now under consideration. From the dermatologic standpoint, infrared rays are not of great interest. There are, however, three conditions which are due at least in part to these spectral segments. The simplest of these is erythema ab igne, which can be due to repeated exposures to the heat of the sun but is more typically seen as a result of long continued baking in front of a stove or hearth. In this process, a reticulated erythema is constantly renewed by repeated vascular dilatation. This is followed by diapedesis, which leaves a permanent hemosiderin deposit and the definitive clinical picture. At this stage nothing can be done to reverse the process. It is of no significance except from the cosmetic aspect. The second condition which is probably entirely dependent on simple heat rays is miliaria rubra, usually known as prickly heat. Occasionally yeast-like organisms have been found on the surface of the affected skin. However, the etiologic role of these organisms is doubtful. They are probably secondary invaders. Prickly heat develops acutely, with itching, burning and sweating, together with a diffuse erythema and pinhead-size papules and vesicles. In the course of a few days the vesicles become flaccid and turbid. This development is followed by superficial peeling. The various dermatologic conditions which are produced or accentuated by radiant energy are discussed. The possible interrelations between light sensitivity, vitamin and porphyrin metabolism, and liver function are mentioned. The management of the various light dermatoses is outlined.

The Value of the Laboratory in the Diagnosis of Poliomyelitis. Max J. Fox, and Hobart E. Wallace.

Am. J. Med. Sci. **217**:401 (April) 1949.

It is the opinion of the authors that today's ultimate in information regarding this disease can be obtained only in those centers where there exists teamwork between the practicing physician, the fever hospital, the virology laboratory, the public health investigator and the research facilities of the medical school.

The urgent need for laboratory collaboration was vividly brought home to us during an outbreak of anterior poliomyelitis occurring in the late summer and fall of 1947 in the Milwaukee area.

In this epidemic skeletal muscle involvement was limited to varying degrees of spasm. This is in direct contrast to the experience of former years when severely afflicted patients were transferred to other institutions for continuation of their long periods of convalescence and physical therapy.

Sera from afflicted patients of the 1947 outbreak did not reveal the presence of several types of encephalitis in this group. However, no studies could be made of the stools of these patients for the presence of the poliomyelitis virus.

The need for facilities to study patients for the presence of poliomyelitis and other viruses exists in most fever hospitals throughout the country. The authors believe that when the viral laboratory becomes an active part of most fever hospitals, definite progress will be made in the study of the nature of poliomyelitis and the answers to its protean nature.

Treatment of Neurosyphilis with Penicillin Combined with Artificial Fever. Norman N. Epstein, and Jules M. Key.

Arch. Dermat. & Syph. **60**:543 (Oct.) 1949.

Eighty-seven patients with various forms of neurosyphilis were treated with penicillin combined with artificial fever therapy.

Penicillin was administered in two forms: (a) aqueous penicillin sodium, intramuscularly, every three hours around the clock over a fourteen-day period, for a total dose of 4,500,000 units, and (b) penicillin calcium suspended in peanut oil containing 4.5 per cent white wax U. S. P., administered in daily single intramuscular injections of 300,000 units each for twenty days, for a total of 6,000,000 units.

Artificial fever therapy was administered by the blanket method during and subsequent to the penicillin course. Five hours of a temperature over 40 C. (104 F.) was considered a single treatment. Most of the patients received a total of fifty hours of fever therapy.

The data on 55 of the patients treated are presented.

The clinical response in the patients with dementia paralytica and meningovascular neurosyphilis was satisfactory. Little change in the clinical condition was noted in those with tabes dorsalis. The response in regard to spinal fluid abnormalities was excellent.

The fever therapy was well tolerated by all but 2 patients. The combination of penicillin and fever therapy gave better effects in our hands than did chemotherapy combined with fever therapy. Penicillin therapy of neurosyphilis, although superior to any other single therapeutic procedure, has its limitations. The effects of artificial fever combined with penicillin therapy should continue to be investigated.

Diagnosis and Treatment of Multiple Sclerosis. Hans H. F. Reese.

Postgraduate Med. **6**:127 (Aug.) 1949.

All treatments as advocated must be accompanied with rest cures. The patient should not be inactivated, but under guidance must at once start reeducational exercises in recumbent and upright positions and start very soon walking and balancing functions.

The treatment is to be individualized in a broad sense supporting. Only in selected early cases, if the patient is not sensitive to histamine, histamine infusions as advocated by Horton of the Mayo Clinic will give good results. The main activity in the restoration of the static and equilibratory functions are supervised reeducational exercises for the whole body system which thereafter have to be continued at least two, preferably four, times daily by the patient. Intercurrent infection in a given case with established multiple sclerosis necessitates bed rest and the usual precautions against dissemination of an infection.

The Diagnosis and Treatment of Vascular Diseases. R. H. Goetz.

Brit. J. Surg. **38**:24 (July) 1949.

The results that are obtained with the portable digital plethysmograph are not only referable to the blood-flow through the skin but are also representative of the peripheral circulation in a strict sense.

The method registers the blood-flow accurately under most physiologic conditions and furnishes a record which is standardized. The results, therefore, can be compared from patient to patient.

The method lends itself easily to routine clinical investigation, in the ward, the operating theatre, or at the patient's home.

It is in the early and doubtful case when plethysmography is most helpful in confirming or excluding the existence of an arterial lesion. At that stage skin temperature readings may still give normal values, with the result that many an early case is missed unless we resort to plethysmography.

Mention is made of the difficulties involved in translating skin temperatures into rate of peripheral blood-flow. Successful treatment depends to a large degree on the correct diagnosis in the

incipient stages of the disease. Plethysmography therefore is not only an important adjunct in the investigation of peripheral vascular disease, but also points the way to a more rational approach in their treatment. The importance of measuring the peripheral (ultimate) blood-flow in contrast to the penultimate circulation has been stressed. It is pointed out that the danger to the patient's limb or life does not come from a deficiency of the blood-flow through the muscles, but from interference to the blood-flow through the skin, i. e., not from intermittent claudication but from threatening or developed gangrene. It is for these reasons that exact evaluation of the ultimate blood-flow in each case of arterial disease is of such importance, irrespective of the fact whether he does or does not present with signs and symptoms in reference to the blood-flow through the skin.

Effects of Ultraviolet Radiation on the Exposed Brain. Arthur R. Elvidge, and Arthur A. Morris.

Arch. Neurol. & Psychiat. **62**:127 (Aug.) 1949.

The recent introduction of ultraviolet radiation for antibacterial purposes has led to its use on the exposed human brain during neurosurgical procedures. Since the need for antisepsis is more important in the longer neurosurgical procedures, the necessity of knowing the prolonged effect of radiation on the exposed animal brain seems to be of immediate importance.

Ten cats were subjected to bilateral craniotomies. Ultraviolet radiations, having 80 per cent of their wavelengths in the vicinity of 2,537 angstrom units, were allowed to project onto one hemisphere for five hours, while the other hemisphere, used as a control, was shielded from the radiations. Pathologic studies were made after the animals were killed, on the third, fourth or fifth postoperative day.

Exposure of the cat brain to ultraviolet radiation under actual human operating conditions produced dilation of meningeal and cortical vessels, usually within thirty to sixty minutes. Gross congestion subsided in twenty minutes by elimination of the ultraviolet radiation. Reirradiation, however, provoked a rapid redilation.

Petechial hemorrhages were observed on the irradiated side on all animals at autopsy, on the third or fifth postoperative day. In 1 animal cortical petechiae were already visible toward the end of the five hour exposure.

On inspection of the exposed cortex slight edema was suspected in only a few instances on the irradiated side. It was difficult to evaluate and recognize during exposure. However, in all the cases gross edema was observed at autopsy and was greater on the irradiated side.

Cortical electrograms were taken throughout the exposure in 4 animals. In 3 experiments depression of activity occurred after an exposure of one hour. In 1 animal epileptiform spikes developed after one hour, and this animal had a clinical seizure at the end of five hours. The electrographic alterations supervened during the stage of vascular congestion.

An intense inflammatory response was observed in the irradiated area. This consisted of vascular congestion of meningeal and cortical vessels; transudation of serum; cellular exudate, with cuffing of vessels; diapedesis, and numerous petechial hemorrhages.

Within the irradiated hemisphere ganglion cells were reduced in number, showed swelling and disruption of cell membranes and occurred as pyknotic forms in the more superficial layers.

Fibrous astrocytes showed evidence of mild hyperplasia of their projections on the irradiated side. The oligodendroglia remained normal, except about cysts and hemorrhages, where acute swelling occurred. The microglia was reactive, especially in the plexiform layer over the irradiated hemisphere.

It is concluded that prolonged ultraviolet irradiation of the brain is harmful and that further investigation is necessary to establish how long the brain may be irradiated without showing irreversible pathologic effects. Physiologic and electrographic observations during ultraviolet irradiation of the exposed brain suggest that with frequent irrigation of the brain, exposure of thirty to forty-five minutes will not result in permanent harmful effects.

Enhancing Photodynamic Effect of Solutions of Crude Coal Tar on the Skin. Lawrence Frank.

Arch. Dermat. & Syph. **60**:597 (Oct.) 1949.

The work reported in this paper is part of a problem concerned with the development of a method for the effective treatment of psoriasis by photodynamic action.

Lewin was the first to recognize that coal tar products are capable of rendering the skin sensitive to sunlight. He found that most of a large group of persons who came repeatedly into contact with certain coal tar products had dermatitis and itching when they were exposed to sunlight.

Foerster and Schwartz demonstrated the photosensitizing effects of pitch, containing a high percentage of crude coal tar, when sunlight was the source of radiant energy. They were unable to obtain any reaction with the mercury vapor lamp or the carbon arc lamp using a therapeutic C carbon electrode. The work presented in this paper does not necessarily conflict with the results of Foerster and Schwartz for the reason that the carbon arc radiation was not produced in identical fashion in both series of experiments. The quality of radiation from the carbon arc depends on the following factors: the size and the kind of electrodes, the direction of the current, when direct current is used through combinations of neutral-cored and impregnated carbons, and the amount of the electric current. The limits of the effective spectrum for photodynamic action allow only the use of the sun and of the carbon arc for the production of photosensitization of the skin with

tars. To increase the intensity of photodynamic action on the skin beyond that reported in this paper, it will be necessary for one to take into account the factors affecting carbon arc radiation, the nature of the photosensitizing chemical and the solvent as well as the wetting agent employed in conjunction with this chemical.

The inclusion of a wetting agent in solutions of crude coal tar, in conjunction with the use of the carbon arc as a source of radiation, enhances the photodynamic action of such solutions on the skin.

Isolated Paralysis of the Serratus Anterior Muscle. J. P. Griffin.

J. Indiana M. A. **42**:1068 (Oct.) 1949.

Isolated paralysis of the serratus anterior is caused by a malfunction of the posterior thoracic nerve (external respiratory nerve of Bell), which innervates it.

Treatment of this unusual condition should be conservative. Most of the cases not involving an actual severance of the nerve will recover completely within three months to three years. Some form of immobilization of the arm with the scapula against the thoracic cage is considered ideal. A shoulder spica, special braces, or even a simple sling, accomplish this end with more or less success. Heat, massage, and heavy doses of B_1 are helpful. Actual electrical stimulation of the muscle is not considered to be worthwhile. Operative interference usually is done, either to make a nerve anastomosis or to make a muscle transplantation. Neither type of surgery has many adherents, nor does the wiring of the scapula to the underlying ribs offer much chance of success.

The Shoulder-Hand Syndrome: A Complication of Coronary Artery Disease. A. W. Hilker.

Ann. Int. Med. **31**:303 (Aug.) 1949.

Eleven cases that developed a shoulder-hand syndrome as a result of severe coronary insufficiency or myocardial infarction are reported. The symptomatology is discussed and the condition described in its three stages. Two of the 11 cases developed the shoulder-hand syndrome without evidence of acute myocardial infarction but both had angina with effort and evidence of left heart failure. The nine remaining cases all had severe myocardial infarction. All patients had marked electrocardiographic changes, high sedimentation rates, prolonged hypotension and evidence of forward failure for a week to several weeks following occlusion. In this series of cases no patient developed the shoulder-hand syndrome unless there was myocardial failure and prolonged hypotension. There is an apparent direct ratio between the severity of the myocardial infarction and the development of the shoulder-hand syndrome. It might be stated that the incidence increases in proportion to the size of the infarction. Two of the nine cases developed the far advanced trophic changes described as the third stage. Both had severe anterior myocardial infarction and both had pulmonary complications, providing multiple causes for progression of the syndrome. Those patients who regained good myocardial function tended to reverse the shoulder-hand syndrome toward normal, whereas persistent myocardial insufficiency tended to aggravate the shoulder-hand syndrome. Recent neurophysiologic concepts are described as possible explanation of this syndrome and additional factors are suggested as possibly entering into the complex chain of events that are required for the development of the shoulder-hand syndrome.

Observations on "Major" and "Minor" Causalgia. Francis Echlin; Frederick M. Owens, Jr., and Warner L. Wells.

Arch. Neurol. & Psychiat. **62**:183 (Aug.) 1949.

Pain is the central feature of causalgia. Vasomotor and trophic changes are variable and for the most part nonspecific. They are not an essential part of the syndrome. Severe, or major, causalgia resulting from war wounds of large peripheral nerves is commoner than has usually been reported. The majority of patients with major causalgia show gradual spontaneous improvement. The classic syndrome of causalgia is seen in its complete form only during the period that the condition is at its height. As improvement occurs in a case of causalgia, all gradations of intensity in the condition may be seen. During the period of improvement in a case of severe causalgia, the condition may be described as one of minor causalgia. Some patients present the picture of a minor causalgia without ever passing through a phase of severe or major causalgia. Realization that causalgia may exist in a mild, or minor, form is important, as the condition is probably more common in civilian life than generally recognized. The same abnormal mechanisms are apparently operative in all cases of causalgia, regardless of intensity.

Although gradual improvement is usual in a case of causalgia, this may not take place for months or even years in some cases. In the interval progressive and irreversible changes may occur in the tissues and perhaps even in the emotional stability of the patient. In addition, the patient may be left with a disagreeable minor causalgia. Adequate treatment should, therefore, be instituted early. An injured nerve should be appropriately treated on its own merits. Coexisting causalgia may thereby be relieved, especially if neurorrpahy is the procedure of choice. The individual case of causalgia should be evaluated with respect to its duration, severity and response to the conservative expedients of physical therapy and sympathetic block. These measures failing, sympathectomy should be done in cases of severe causalgia if sympathetic block has given temporary relief. In such circumstances sympathectomy has been curative in the majority of patients, at least during the period of their follow-up.

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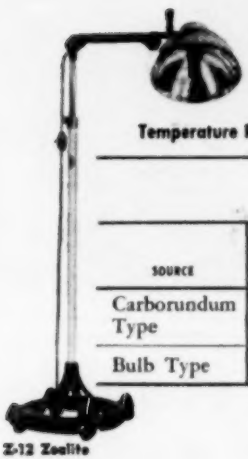

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*Arch. Physical Medicine, 30:691-99 (November) 1949.

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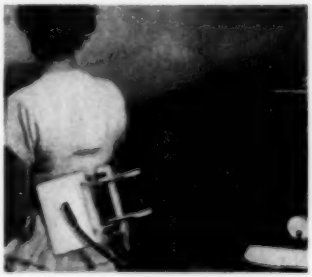

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	Harold B. Luscombe, Col., M.C. Olena M. Cole, Capt., WMSC	Completion MFSS	12[13]	June	10	None	Certificate
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SATURDAY, APRIL 29, 1950 AT 2:00 P.M.

George Washington University Hospital

901 23rd Street, N. W. **Washington, D. C.**

1:00 P.M. Registration and Tour of the Department of Physical Medicine, George Washington University Hospital, Washington, D. C.

AFTERNOON SESSION — 2 P.M.

1. **Rehabilitation in Chest Surgery** — BRIAN BLADES, M.D., Prof. Surgery, George Washington Univ. School of Med., Washington D. C.; Director Thoracic Surgery, VA, and Consulting Surgeon, Walter Reed Hospital.
   Discussion: Lt. Col. John H. Kuitert, M.C., Chief, Physical Medicine, and Director, Army School of Physical Therapists, Clinical Branch, Walter Reed General Hospital, Washington, D. C.; Harry Kessler, M.D., Dept. Physical Medicine and Rehabilitation, VA, Washington, D. C.; Sidney Licht, M.D., Assistant Professor of Physical Therapy, Sargent College.
2. **The Use and Abuse of Physical Therapeutic Measures in Peripheral Vascular Diseases** — ANDREW G. PRADONI, M.D., Associate in Medicine, George Washington Univ. School of Med., Washington, D. C.; Consultant, Walter Reed General Hospital, Washington, D. C.
   Discussion: A. A. Martucci, M.D., Chief, Physical Medicine and Rehabilitation, Phila. General Hospital; William Bierman, M.D., Asst. Clin. Prof. Medicine, Columbia Univ. College of Physicians and Surgeons, N. Y. C.
3. **Fractures at the Elbow — Indications and Contraindications of Physical Therapeutic Measures** — MILTON C. COBEY, M.D., Assoc. Prof. Orthopedic Surgery, Georgetown Univ. School of Med.
   Discussion: Bror S. Troedsson, M.D., Director, Dept. Physical Medicine, Orange Memorial Hospital; Harold Lefkoe, M.D., Orthopedic Surgeon, St. Luke's and Children's Medical Center.

INTERMISSION

4. **Contraindications for Physical Medicine in Neurologic Conditions** — WALTER FREEMAN, M.D., Prof. Neurology, George Washington Univ. School of Med., Washington, D. C.
   Discussion: Richard Kovács, M.D., Prof. Phys. Med., New York Polyclinic Med. School and Hosp.; Charles A. Furey, M.D., Asst. Chief, Dept. Physical Medicine and Rehabilitation, Phila. General Hosp.
5. **Rheumatoid Spondylitis** — DARRELL C. CRAIN, M.D., Clin. Instructor Medicine, Georgetown Univ. School of Med.
   Discussion: William Benham Snow, M.D., Chief, Physical Medicine, Columbia Univ. College of Physicians and Surgeons, N. Y. C.; Jessie Wright, M.D., Director, D. T. Watson School of Physiatrics, Leetsdale, Pa.

DINNER 6:30 P.M. AT THE WILLARD HOTEL
GREETINGS FROM CHAIRMEN OF COMPONENT SOCIETIES

EVENING SESSION

7:30 P.M. PANEL-SYMPOSIUM: "SHOULDER"

Moderator — WILLIAM H. SCHMIDT, M.D., Director, Department Physical Medicine, Jefferson Medical College and Hospital, Philadelphia.

1. **Functional Anatomy of the Shoulder** — OTHMAR SOLNITSKY, M.D., Prof. Anatomy, Georgetown Univ. School of Med.
2. **Orthopedic Aspects of Shoulder Disabilities** — CARL BERG, M.D., Asst. Clin. Prof. Orthopedic Surgery, George Washington Univ. School of Med.
3. **Physical Medicine in the Treatment of Shoulder Disabilities** — K. G. HANSSON, M.D., Assoc. Prof. Cornell Univ. Med. Coll.; Director, Physical Medicine, Hosp. for Special Surgery and New York Hospital.

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Secretary
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28th Annual Session, Hotel Statler, Boston, Mass., August 28, 29, 30, 31, September 1, 1950

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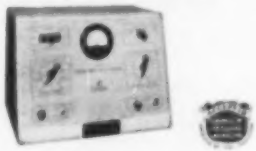

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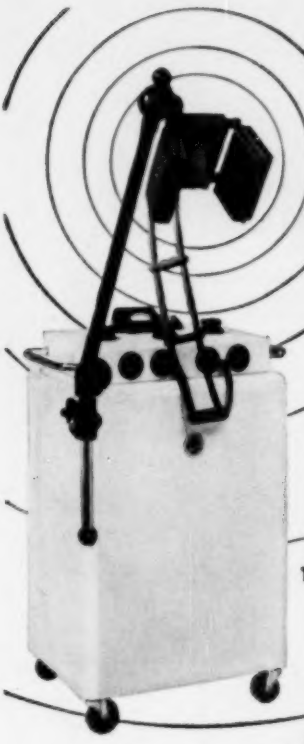

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